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Engineering News-Record

A McGRAW-HILL PUBLICATION

May 1, 1930

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Manufacturing High-Modulus Footbridge Cables

For Fort Lee - Hudson River Bridge

By C. C. Sunderland

Chief Engineer of Bridges
John A. Roebling's Sons Company

Water Supply and Sewerage in Japan

By Harold E. Babbitt

Professor of Sanitary Engineering
University of Illinois

Constructing Framed Mattress for Mississippi River Revetment

Small Siphon Spillway in Vancouver Reservoir

Studies of Pipe Joints and Pipe Coatings

Repair of Damaged Bascule Leaf at Rochester, N. Y.

Annual Meeting of Welding Society

Report of Civil Engineers' Spring Meeting at Sacramento, Calif.

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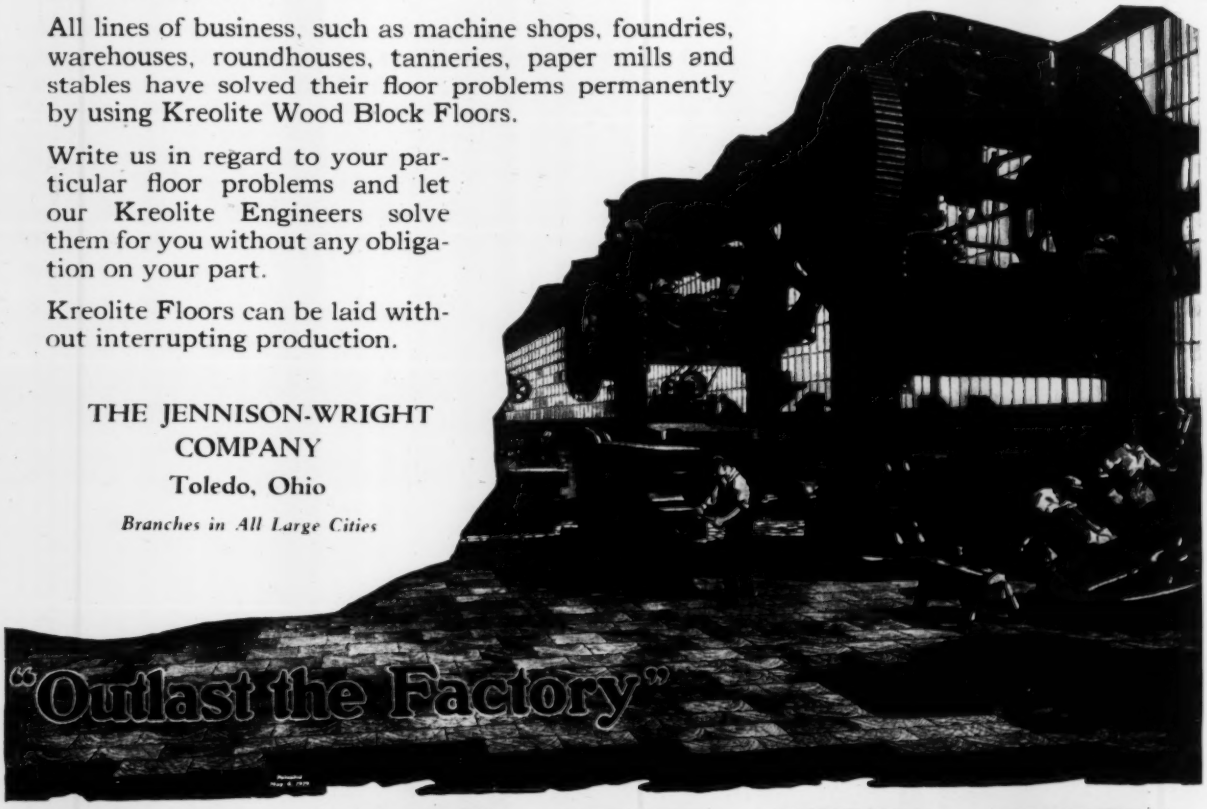

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ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION — ESTABLISHED 1874

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT: *Editor*

Volume 104 NEW YORK, MAY 1, 1930 Number 18

Water Problems Grow

DISCUSSIONS at the Sacramento meeting of the American Society of Civil Engineers last week illustrate again the ever-increasing importance of water problems throughout the arid and semi-arid states. Cost estimates on two water-development projects now in focus in California run far into the hundreds of millions of dollars. For one project on which a million dollars has been spent in investigations a cost of seven hundred millions was mentioned in a paper by the state engineer. And not only are water problems becoming larger in magnitude, but they are increasing in complexity, as witness the increased importance of underground water rights and distribution. More and more they are affecting other fields of activity. Thus, the economic, financial and political interrelationships which they involve call upon the engineer to broaden his activity and his vision. Engineers are destined to be the leaders in Western water conservation; to lead effectively they must learn to think in larger and broader terms than ever before.

Responsibility for Disaster

NON-FIREPROOF buildings, some of them said to be a hundred years old; condemned a quarter century ago as unfit for further use, but nevertheless kept in service year after year; crowded to more than double their capacity; such was the Ohio state prison, in which more than three hundred prisoners were burned to death last week when fire swept through several cell blocks. The result was the all but inevitable outcome of the conditions which the state created and continued. A week has been spent in investigating, in inquiring how the fire started and why action to rescue the inmates was delayed. No question has been raised concerning the years of official neglect that kept obsolete, dangerous buildings in use for public institutional purposes. All details aside, the fundamental responsibility for the terrible happening rests on the legislators and officials whose consistent inaction made it possible. An indictment lies against the State of Ohio and its chosen representatives. But, unfortunately, they are not the only ones who are thus culpable. Institutional and other public buildings exist elsewhere in the country that are vulnerable to fire and to fire panics, yet continue in use because public officials place careless trust in the chance that fire will not start. Perhaps the Columbus disaster will stir official conscience and lead to a beginning of improvement.

Qualifying Welders

PROOF, if proof were needed, of the efficacy of qualification tests for welders was furnished convincingly by the progress report of the structural steel welding committee at the convention of the American Welding Society last week. Plotted values of ultimate strengths of more than 1,000 welded joints of various types and sizes made by welders in some 40 widely separated fabricating shops appeared as large black spots on the charts, so close was their agreement. Also, no striking difference was apparent between gas- and arc-welded specimens. This gratifying uniformity can be ascribed to no single factor more than to the qualifying tests which each welder was periodically required to pass. Briefly, these tests involved making test coupons by both horizontal and overhead welding which should average 45,000 lb. per square inch breaking strength in the weld metal. The actual average for the 33 welders who qualified, all of them run-of-shop welders, was 54,000 lb. To the engineer who desires to use welding but is held back by the fear that the human element cannot be eliminated with certainty, the uniformity of these test results should prove a great satisfaction. The men who made the welds were kept on the alert by the qualification tests. There is no reason to believe that the same alertness and efficiency should not be capable of being developed on all routine or special shop and field work. If this is true, qualification tests, carefully and periodically administered, should lend assurance to the engineer who designs the structure and to the contractor who fabricates and erects it. Indeed, welding contractors might give some thought to devising a system of qualification certificates.

Tribute to Brush Revetment

BRUSH mattress revetment is a fine old classic of bank-protection engineering on the Mississippi. For half a century it has been one of the chief resources of the river engineer in holding the sugar-like delta soils from melting under the drive and cut of the river currents. Now it is giving way to concrete. The new machine-produced material is cheaper, and it endures better the attack of disintegration in that danger zone of alternately dry and submerged riverbank. More as a tribute to past importance, therefore, than as a recognition of present usefulness a description is published in this issue of one of the two types of Mississippi brush mattress revetment that have proved proficient in their exacting task. The framed mattress of the lower delta reaches of the Mississippi is distinct in both structure and fabrication process from the fascine mattress of the middle and upper delta which will be described in a succeeding article, but the two types have one common feature that is of determining importance: the willow brush from which the mattress is built. In this identity of material lies a profound reason why both types are meeting the same fate. There are no more great banks and bars of willows; only scattered growths are available without going far afield. The willows have been cut and fabricated into revetment during half a hundred years of Mississippi River channel improvement. In that same time, moreover, labor has become too expensive for an exclusively hand operation. The excellent technique of building and sinking which has come to perfection from

repeated use is now about the only possession that enables brush mattress revetment to maintain a place in the river work. This technique is a notable example of the high possibilities of training men performing the most common manual processes to scheduled concerted action. A mattress weaving and sinking operation on the Mississippi furnishes one of the best illustrations that can be found today of the masterly direction exercised by the builders of the day when men working together with their hands performed all construction.

Dangerous Hoisting

A BUNDLE of steel beams is a hazardous load to dangle over a public thoroughfare. When, in addition, two or three dozen kegs of rivets are thrown loosely on the bundle of beams and this combined load is hoisted over the heads of pedestrians, it is a plain case of flouting disaster. Such a performance seems so foolhardy as to be almost incredible, yet is actual practice in the erection of a building now being constructed in the business district of a large city. The public's implicit faith in the undertakings of engineering construction and its reliance on the protection of a narrow sidewalk bridge would be rudely shaken if a 200-lb. keg of rivets should roll off a swinging load of beams and come crashing down through the roof of the bridge. Speed, the god of modern building construction, seems to have routed even common sense in this case. Perhaps, though we doubt it, enough time is saved by discarding the conventional skip in hoisting kegs of rivets to enable the building to be completed a few hours earlier; but even so, is the danger to the public worth it? We think not, and condemn this practice as wholly unsafe and unwarranted.

Practical Research

SUSPENSION bridge cable construction, an art that saw but slow advance during a quarter century or more, enters a new period with the 3,500-ft. span of the Fort Lee bridge. Radically new methods are being used, embodying highly original thought and extensive shop research; their success is attested by the fact that the four 36-in. cables reached the halfway mark toward completion last week, after barely five months' work, a warranty that they will be completed well before the schedule date of next December. These new methods resulted from the special problems involved in the unprecedented size of the operation—not only the great length of span but also the enormous mileage of wire to be strung. The contractor realized the situation at the beginning, and casting aside accustomed practice he studied the several requirements of plant and operations on first principles, checking his conclusions by experiments and model tests. The results include among other items a new footbridge construction and remarkably interesting new stringing mechanism by which a wire speed twice that previously reached is attained. One of the fundamental items, the production of footbridge ropes possessing a high elastic modulus and freed of their inelastic stretch, is described this week. Prestretching of the ropes is the essential means by which the modulus is raised to 18 million pounds per square inch, and this required a stretching device nearly half a mile long, able to apply a load of 300 tons. The equipment developed for these particular ropes soon was put to use also in the production of high-modulus strands for the main cables of two other suspension bridges, which again opened new structural possibilities. Altogether, the development work whose first element is now set forth not only has strong technical interest but also is valuable as an example of how effectively special study and research can advance the range of construction.

Breaking Ancient Walls

MANY centuries ago China walled itself in, physically and mentally. What good its great stone wall may have done it then and whether it has been harmful since are matters of small moment today compared with the walls against mental and national progress which China has maintained since. For two or three centuries Japan far outdid China in maintaining a wall between itself and other nations. Considerably less than a century ago Commodore Perry, of the United States Navy, "opened" Japan to the world. The time must have been ripe for a profound change in Japan, manifested outwardly by establishment of intercourse with all the civilized world and inwardly by a self-denying ordinance of the ruling class of Japan, the leaders of which not only gave up their old dominance of the government but also threw aside the two swords which had been their distinguishing mark among the common people. Some examples of Japan's progress in municipal water supply and sewerage are given in the second installment of Professor Babbitt's observations on engineering in the Far East, printed in this issue. The backwardness of China, shown in Professor Babbitt's earlier article, illustrates the handicaps under which that country remains through not having broken down its ancient walls against progress.

A Warning to Utilities

ATTEMPTS to make radical changes in the public utilities laws of New York State at the recent session of the legislature were not successful. Many of the bills introduced either failed of passage or were so altered in passage as to render them harmless. The majority of the legislature did not approve of making radical changes in the law, but the minority, with which the Governor is in sympathy, would have greatly strengthened the control of the Public Service Commission over utilities, especially over holding companies and over methods of accounting and of setting up valuations for rate-making purposes.

The minority program may be summed up as follows: (1) assertion of the state's determination that the return to which owners of privately owned utilities are entitled shall be the original cost of the property used and useful in the public service, as shown by their books; (2) establishment of a uniform system of accounting which will make available accurate unit cost analysis of all classes of service, such as any modern corporation in competitive industries would insist upon; (3) provision for municipal ownership and operation of public services on a referendum vote of their citizens expressing their desire to undertake such enterprises, as a means of injecting the potential element of competition.

This minority program received strong support. A growing sense on the part of the public of the need for adequate control of holding companies, and dissatisfaction with best methods of valuation, indicate that it will receive more support in the future. The public utilities need to recognize this fact and adopt a more conciliatory attitude if they are not to be saddled with much undesir-

able legislation. Governor Roosevelt stated that the weight of evidence gathered by the commission on revision of the public service commission laws showed the "absurdity of putting any faith in the willingness of big utility corporations to give up gains, that the attitude of the utility representatives at the Senate committee hearing showed beyond contradiction that they regarded themselves as entirely private enterprises and that they are ready to oppose any attempt to assert the public's interest."

It is not necessary to accept this official characterization in full to become convinced that its general tenor truly reflects the present-day situation. Antagonism between utilities and their clients, the consumer public, is growing, and growing largely because of the isolationist instead of co-operative attitude of the utilities themselves.

The public's interest will be asserted. How deeply it will penetrate into the control of public utilities will depend in large part upon the future attitude of the utilities toward the public which they serve.

Financing River Crossings

THE states of New York and New Jersey have abolished the commissions which built the Holland tunnel under the Hudson River at New York and have turned the tunnel over to the Port Authority—an interstate body—for operation and maintenance. Further, the states have instructed the Port Authority to proceed with studies for a new tunnel north of the Holland tunnel and have allocated part of the receipts from the Holland tunnel to defraying the expense of such studies. Assuming that the Port Authority is the proper body to build this interstate river crossing, the step is a logical one. Under mandate from the two states the Port Authority is now building two great interstate bridges and has built two others. If it is to continue in that work, there appears to be no reason for continuation of the two commissions simply to operate the Holland tunnel. On that basis, this recent action of the two states is commendable.

This journal does not believe that the Port Authority should be continued in the bridge-building business. It would have preferred to see the tunnel commissions continued with the present bridge construction work and the proposed tunnel construction work turned over to them, all new work being financed directly by the two states as was done in the case of the Holland tunnel and the Philadelphia-Camden bridge.

Unquestionably the Port Authority, with its power to issue bonds which in theory at least are not obligations of the two states, is a convenient agency to undertake such large construction tasks and relieve the state legislatures of the responsibility of financing them directly. Also, the successful financing of the two bridges already built has tended to strengthen the financial position of the Port Authority itself, thus placing it in a better position to undertake the task for which it was set up. Nevertheless, the continuation of such essentially public facilities as bridges and vehicular tunnels under the control of a body like the Port Authority is fraught with possibilities which may be detrimental to the traffic which they are designed to serve.

The Port Authority, by its nature, must frequently undertake the financing of new port facilities. Also, its natural tendency has been and will be that of taking on new obligations such as the present suburban transit survey, many of which will not be revenue-producing. There will, therefore, be a strong urge to use the income from revenue-producing facilities like the Holland tunnel for financing non-revenue-producing activities. For example, nothing in the law which turns the Holland tunnel over to the Port Authority obligates it to reduce the tolls in the tunnel to an amount only sufficient to cover operating and maintenance costs as soon as the bonds are paid for. They may be continued and used for other purposes.

In such a situation, given a small organization with the sole object of constructing and operating interstate tunnels and bridges, the reduction of tolls to a minimum required for operating and maintenance costs, or even the entire elimination of tolls, if that seems desirable in the future, can be looked for with reasonable assurance; but with the bridges and tunnels in the hands of the larger organization with its diversified interests and growing expenses, the day when tolls will be reduced or eliminated appears far distant.

Therein lies the danger of the present arrangement. If the Port Authority is to continue its control of interstate highway facilities, that control should be so hedged about by safeguards as to insure their not being used to finance or bolster up unrelated projects.

Gas and Water Pipe

THOUSANDS of miles of cast-iron pipe lie beneath the streets of our cities. Upon its integrity depend the water and gas service to millions of homes. Leaks in these pipes mean waste to cities and utility companies and possible damage to property and loss of life. The menace of breaks is greater than the menace of leaks, thousands of which go for years undetected.

Associations and pipe manufacturers have devoted much study to cast-iron pipe, its joints and its protective coatings to throw light on the causes of leaks and of breaks at joints and in the runs of pipe between. Although there are great differences in the material conveyed by gas and by water pipe, so many things have bearing upon the integrity of these conduits when used for either purpose that studies for the benefit of one class of makers and users may be of equal benefit to the other. For this reason water-works men should welcome the review of discussions of joints and coatings before the recent distribution conference of the American Gas Association, summarized elsewhere in this issue.

Three points in the discussion may be noted. First, that one of the sets of tests reported showed that cement joints were better than lead in resisting transverse pressure, as to both leakage and deflection. Conclusions in favor of cement joints that might be drawn from these tests are to a degree upset by those resulting from another set of tests, said to show that cement joints are not dependable for other than low-pressure gas distribution. In considering this conclusion, water-works men will naturally take account of the differences between water and gas when under pressure. A second point to be mentioned here is the strong testimony on the menace of joints caused by settlement strains—greater, one set of tests showed, than that due to temperature stresses. A third point, and one seldom if ever brought up before, is that trench settlement may distort and disrupt bituminous coatings because of adherence of trench dirt to the coatings. These and other points developed at the conference lend new emphasis to the fact that men engaged in one field of work need to keep informed on what is going on in other fields.

Manufacturing High-Modulus Footbridge Ropes for Fort Lee Hudson River Bridge

Modulus of Elasticity of 6x37 Rope Increased from 12,000,000 to 18,000,000 Pounds Per Square Inch by Prestressing to 125 Per Cent of Working Stress—Process Applied Also to Strands for Main Cables of Grand'Mere and St. Johns Bridges

By C. C. Sunderland
Chief Engineer of Bridges, John A. Roebling's Sons Co., Trenton, N. J.

One of the First Problems confronting the cable-spinning contractor on the 3,500-ft. Fort Lee-Hudson River suspension bridge was the design of suitable footbridges from which the four 36-in. diameter cables of the bridge could be spun. No ropes so long as would be required to support these walks had ever been built for such exacting service. It was particularly important that the ropes have a uniform modulus of elasticity and that this modulus be as high as possible. Rope-making machines are built on the principle that manufacture must be done under considerable tension so that the wires will be closely compacted, but no machine available would make these 2⅛-in. diameter ropes so that they would compact under a working load of 160,000 lb. Therefore, it was necessary to stretch these ropes after fabrication to loads in excess of the maximum working load, in order to eliminate erratic or excessive sags. The equipment necessary for this prestressing is described in this article. Some idea of the magnitude of the operation may be obtained from the fact that 185,000 ft., or 2,682,500 lb., of rope was manufactured for these footbridge cables. This weight of wire is sufficient to construct the main cables for a 1,200-ft. span highway bridge with a 40-ft.-wide concrete roadway. The successful development of this process of multiple stressing is one of the most important advances made in the suspension-bridge field in many years. Already this same equipment has been utilized to manufacture rope strands for the 987-ft. span Grand'Mere bridge in Quebec and for the 1,207-ft. span St. Johns bridge in Portland, Ore. It is interesting to note that no footbridge cables are required for these last two structures, and that this method of construction is possible only by virtue of the development work occasioned by the design of the footbridge cables on the Hudson River bridge. —Editor.

A WIRE ROPE is a very elastic structure. For example, in its manufactured state, a well-constructed wire rope with an independent wire rope center has a modulus of elasticity not much in excess of 12,000,000 when first stressed, as compared with a modulus of elasticity for the individual wires of between 25,000,000 and 27,000,000. For general use this high elasticity is desirable, since it tends to dissipate any sudden impact load. Although it is unusual for a new rope to fail, even under impact loads that calculations show to be in excess of the ultimate rope strength, ropes have failed under identical loads after having been in service for only a few months. Investigations of such failures generally show that the wires in the strands and the strands themselves have been worked into close contact in service, reducing the springiness of the construction and resulting in an increased modulus of elasticity.

When wire ropes are used for lift bridge counterweight cables, suspension bridge cables, suspender ropes and footbridge cables on large suspension bridges, where accurate lengths and definite and uniform elastic properties are of major importance, it is necessary to fabricate the ropes with high tension and pressure, in order to approach more nearly the working tension of the rope in service. Proper manufacturing tension and pressure, together with accurately calculated wire sizes, will tend to assure uniformity of the elastic properties, but even these careful methods were not sufficient to produce rope to meet the exacting requirements for the footbridge cables of the Fort Lee-Hudson River bridge.

FIG. 1—NEW JERSEY TOWER OF HUDSON RIVER BRIDGE, SHOWING FOOTBRIDGES
Main cable spinning in progress. Framework on top of tower is runway for 200-ton traveling crane used to lift completed strands into saddles.

The two footbridges of this structure are supported by 36 2⅛-in. ropes in four groups of nine ropes each. As is usual in suspension bridge construction, these ropes are later to be cut up and used as permanent suspenders. Although the most powerful and largest rope-making machine in this country was used to manufacture these ropes, it was not possible to procure sufficient tension and pressure during the fabrication to correspond to the working tension of the rope in service. It was therefore necessary to subject the ropes to additional stretching after they were manufactured.

When a rope is first subjected to working tension its

elongation consists of both an elastic and a structural stretch. The elastic stretch is that portion of the elongation that shows full elastic recovery upon release of tension. The structural stretch is the elongation which occurs over and above the true elastic stretch for any given tension, and does not show full recovery upon release of tension. The structural stretch is not a definite quantity, but is variable, depending on the size and power of the machine used to fabricate the rope, together with knowledge and skill of fabrication. For example, in studying the stress-strain diagram of the rope for the Fort Lee bridge, it was found that when any applied tension between the manufactured tension and the elastic limit of rope was held for a period of time, a continued elongation of specimen occurred. This additional elongation, without increase of load, was due to wires and strands seating themselves in closer contact, and was the structural stretch. Removal of this structural stretch was possible only by multiple stressing before erection.

Each footbridge cable is subject to approximately 160,000 lb. working tension under normal loading, of which 80,000 lb. is the approximate tension due to its own weight (14.5 lb. per linear foot) in suspension on a 3,500-ft. span. The actual elongation of this length of rope between 80,000 and 160,000 lb. tension is very important, since the footbridges must be located at just the proper height to permit construction of the main cables. Any uncertainty as to the structural stretch and permanent set of ropes between these tensions would nullify the careful computations for determining the unloaded deflection of the footbridge cables. We consider the structural stretch removed when the rope shows well-defined and uniform elastic stretch and recovery and when the load is maintained for some time at 80 per cent of prior stressing without showing any additional elongation of specimen.

The ropes were fabricated on an 80-ton rope machine in our Trenton plant, in sets of 7,200-ft. lengths. Each set was then cut in two, wound on reels 9 ft. in diameter and shipped to the plant at Roebling, N. J., where the prestressing, measuring, socketing and rereeling equipment is located.

With the equipment as installed (Fig. 2) it is possible to stress a 3,750-ft. rope to a tension of 300,000 lb. or a 1,875-ft. length to a tension of 600,000 lb. A tension of 200,000 lb. was applied to the 3,600-ft. ropes of the Fort Lee bridge. The equipment consists of a straight standard-gage railroad track, 1,850 ft. long, running approximately east and west, at each extremity of which is located a building. The building at the east end houses a 600,000-lb.-capacity horizontal hydraulic tension testing machine, while the west-end building contains

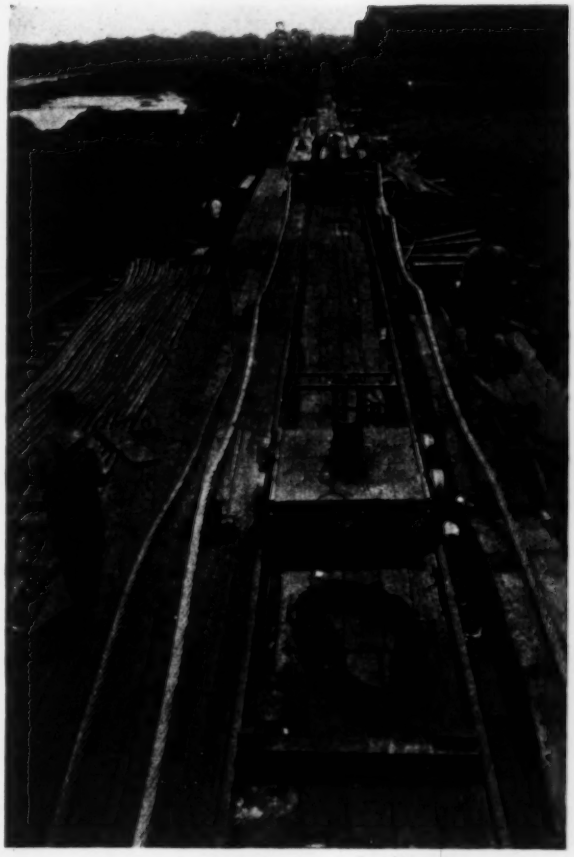


FIG. 3—LOOKING EAST ALONG THE PRESTRESSING TRACK

The special car around which the rope passes and which is attached to the testing machine at the east end is shown.

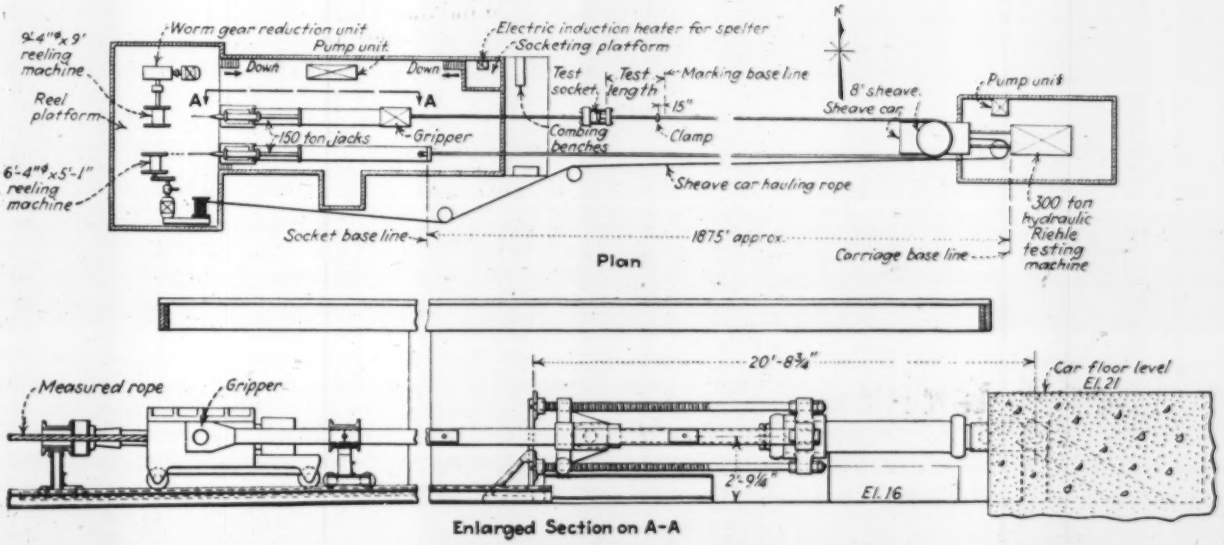


FIG. 2—EQUIPMENT LAYOUT FOR PRESTRESSING WIRE ROPES IN LENGTHS UP TO 3,750 FT.

apparatus for reeling, stressing, gripping, cutting and socketing. Running on this track is a specially designed car (Fig. 3) on which is mounted a horizontal sheave, 8 ft. in diameter. Along each side of the track and 8 ft. apart are 9-in. wide-mouth sheaves set at 25-ft. intervals; these sheaves support the rope being stressed. The stressing equipment at the west end consists of two 150-ton hydraulic pulling jacks (Fig. 2) set 8 ft. on centers, symmetrical about the center line of the track. These jacks have a ram stroke of 5½ ft. and operate under a maximum pressure of 6,000 lb. per sq.in. The outer end of the ram is carried by a crosshead type of carriage and through this head, above and below the ram, are two screw rods. The rods, which serve as a safety device when tension is being held on the strand for a long period of time, are fastened to a yoke which encompasses the barrel of the jack and which also bears against the head of the jack. Passing through the sides of the crosshead and the yoke are two structural steel bars 1x8 in., having 3-in. holes spaced 5 ft. on centers. By pinning these bars to the yoke and removing the pins in the crosshead, the load is held by the yoke until the ram is run out or in for a new hold. In this way a total movement of 20 ft. on one jack and 25 ft. on the other is possible. Attached to the side bars of the north jack is a hydraulic gripper which holds the unsocketed end of the rope during the period of stressing; on the bars of the south jack there is a specially designed receptacle for the socketed end.

For the socketing operation there is a vise mounted on a platform about 10 ft. above the floor. Leading up to the vise is a guide with clamps attached, which holds the rope in a straight line vertical position, to assure that the socket, when put on, is not skewed with respect to the axis of the rope. Immediately in back of and above the jacks are two reeling machines, one to take a reel up to 6 ft. 4 in. diameter and the other to take a reel up to 9 ft. 4 in.

In general, the procedure involved in the prestressing and measuring of the rope is as follows: The reel of rope, as received from the fabrication shop, is mounted in one of the reeling machines and the end pulled out and socketed. This socketed end is put into the receptacle attached to the south jack, and a bight of rope put around the sheave on the sheave car, which is now at the west end. The car is pulled out to the east end and connected to the 300-ton testing machine. The end just coming off the reel is put into the gripper and clamped.

FIG. 4—WEST END BUILDING OF THE PRESTRESSING LAYOUT
In this building, measuring, cutting and socketing are done. The hydraulic jacks to which both ends of the rope are attached are near the door of this building.

The socket on the rope is set so that its face is correctly positioned with respect to a previously determined line. The carriage is also set to a previously determined position. The jack attached to the gripper is pulled in until the tension in the strand, as recorded by the weighing mechanism at the east end, is equal to the measuring tension. Then, by means of the testing machine at the east end, the tension is brought up to the value at which it is to be held for a given length of time. This tension is held by taking up on the 300-ton testing machine to compensate for the elastic and structural stretch of the rope under load.

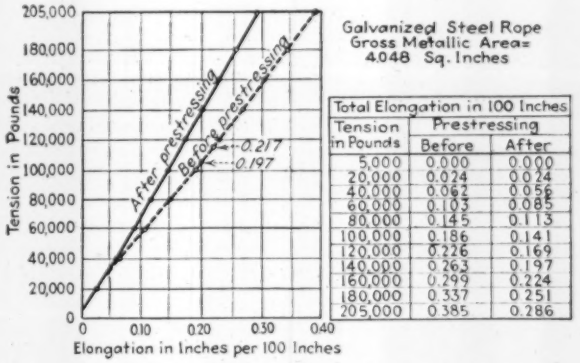
At the end of the given time the carriage is let back to its correct position and the tension brought up to

FIG. 5—MEASURING A ROPE AFTER MULTIPLE STRESSING

the measuring value by means of the gripper jack at the west end. The tension is then dropped well below the measuring value by slacking off on the testing machine and immediately bringing it back to position. The tension is again corrected to the measuring value by the gripper jack, and the slacking off on the carriage is repeated. This procedure is followed until the tension in the rope is correct, and is necessary in order to equalize the tension in the rope at both jacks at the west end; the difference in tension at this end develops from the friction in the rollers on each side of the track by which the two parts of rope are supported at 25-ft. intervals.

With the carriage at the east end and the socket at the west end, properly positioned, and the tension at the correct value, the strand is ready to be measured. The measuring tension is 80,000 lb. as previously noted and the 36 ropes for the main span have calculated lengths from 3,556 ft. 2 in. to 3,557 ft. $6\frac{9}{16}$ in. For the New Jersey and New York side spans, respectively, the figures are 758 ft. 9 in. to 759 ft. $10\frac{3}{8}$ in. and 819 ft. $\frac{9}{16}$ in. to 820 ft. $5\frac{3}{4}$ in. The differences in length of cables are plotted on a pair of rope scales so that when the scales are placed face to face the corresponding marks will coincide. Each scale is then fastened to a batter board, one board on each side of the track and outside of the rope position at a point previously determined from an accurate survey. The distance, then, from the socket position in the south jack, running east to the carriage, around the carriage sheave, then west to the marking station where rope cables are mounted, is the length of the rope at the predetermined tension and the specified normal temperature.

In order to correct for temperatures different from the specified normal, temperature scales are graduated so that the distance between divisions represents the change in rope length per 1 deg. change in temperature. This scale is mounted on top of the rope scale with the normal temperature line coinciding with the line on the rope scale corresponding to the rope being measured. The zero marks on the temperature scales are toward the east, and the graduations are marked in degrees so that, with the temperature scale set for the proper rope number, the marking line is set at the prevailing temperature, as recorded at each end of the layout by precision thermometers. A counterweighted line is stretched across the rope between batter boards and the rope is



Tension in Pounds	Total Elongation in 100 Inches: Prestressing Before	After
5,000	0.000	0.000
20,000	0.024	0.024
40,000	0.062	0.056
60,000	0.103	0.085
80,000	0.145	0.113
100,000	0.186	0.141
120,000	0.226	0.169
140,000	0.263	0.197
160,000	0.299	0.224
180,000	0.337	0.251
205,000	0.385	0.286

FIG. 6—STRESS-STRAIN DIAGRAM OF A FOOTBRIDGE ROPE BEFORE AND AFTER THE MULTIPLE STRESSING

marked at the line. This mark represents the face of the socket, so the length of rope to be allowed for socketing is marked off from this line and the rope cut at the second mark. The piece of rope between the marking position and the gripper is the test sample.

When the rope is marked the tension is dropped to zero, the carriage cut loose from the testing machine and the socket removed from the south jack. This socketed end is immediately put onto the reel and the reeling of the rope carried on while the rope is cut at the mark and the socket attached. The rope number is stenciled on each socket, as well as on the reel, thus giving complete identification before and after the rope is removed from the reel.

Along the eastern half of the layout and on the southern side of the track there are two buildings about 40 or 50 ft. away from the track. During most of the year, and especially during the months of November to April, when the sun is in the south, shadows are cast on the rope by these buildings. It is quite obvious then that the part of the rope in the shadow will have a temperature appreciably below the sun temperature. In fact, measurements of this difference in temperature have shown as much as 15 deg. F. during the winter months and 20 to 25 deg. F. in the summer months. In addition to this a difference in temperature was found to exist between the top side of the rope, exposed to the sun, and the under side, which was out of the sun. It is readily appreciated that it is practically impossible to work out a temperature correction to length for the above conditions that would be accurate. Therefore it was necessary to make the measurements before sunrise, and as it required the remainder of that day to socket and reel the rope and prepare the next rope for prestressing, it permitted the rope to remain under the prestressing tension of 200,000 lb. for about ten hours during the night. This long period of prestressing was an advantage in this particular case, for it assured uniformity of elastic stretch beyond the 160,000-lb. tension and accomplished practically the same result as if the prestressing tension had been 250,000 lb. for a short period of time.

The influence of prestressing is shown by the stress-strain diagram of this rope (Fig. 6) before and after prestressing. The limitation of the manufacturing tension is quite evident.

Tests—The Port of New York Authority's specification for suspender rope required that two test pieces be taken from each set. There were performed in all 27 straight tension and elongation tests and 27 tests with two parts of rope bent over a sheave (21-in. radius to the center line of rope). The typical stress-strain diagrams in Fig. 7 show the uniformity of the prestressed rope. Three of these ropes show a modulus of elasticity of 17,966,000 and the fourth a value of 17,804,000 between 80,000-lb. and 160,000-lb. stress.

The average modulus of elasticity for the 27 tests of prestressed rope was 18,001,400 lb. per sq.in. The average ultimate strength of the rope, based on 27 tests, was 780,000 lb., the highest value being 797,000 lb. and the lowest 734,000 lb. With the exception of this one low value, the maximum variation from the average strength was 14,000 lb. below and 17,000 lb. above.

Based on the 27 tests of rope around a sheave of 42-in. diameter, an average strength of 1,335,800 lb. was secured, or 85.6 per cent of the strength of the two parts of rope.

The calculations for the unloaded deflection of footbridge cables was based on the average modulus of elasticity of 18,000,000, and the cables were erected and adjusted to the calculated unloaded deflection. The loaded cable curve was found practically to conform to the required deflection, and after a period of five months under this loading, the ropes have maintained their origi-

Tension in Pounds	Total Elongation in 100 Inches: Test Piece No. 1	No. 2	No. 3	No. 4	Average
5,000	0.000	0.000	0.000	0.000	0.000
20,000	0.030	0.021	0.025	0.021	0.024
40,000	0.059	0.053	0.059	0.054	0.056
60,000	0.087	0.082	0.089	0.083	0.085
80,000	0.115	0.110	0.118	0.111	0.113
100,000	0.143	0.138	0.146	0.138	0.141
120,000	0.170	0.165	0.174	0.167	0.169
140,000	0.197	0.194	0.203	0.193	0.197
160,000	0.225	0.221	0.228	0.221	0.224
180,000	0.253	0.248	0.256	0.249	0.251
205,000	0.285	0.283	0.291	0.284	0.286

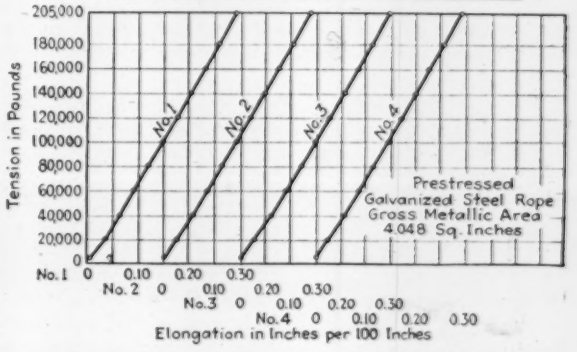


FIG. 7—TYPICAL STRESS-STRAIN DIAGRAMS OF MULTIPLE-STRESSED ROPE FOR HUDSON RIVER BRIDGE FOOTBRIDGE CABLES

nal loaded deflection, indicating that the prestressing has removed the structural set within the range of the working tensions.

The 2⅛-in. galvanized ropes are 6x37 construction with an independent wire rope center, this center rope being equipped with a strand center, the entire cross-section being metallic. Considering that this cross-section is composed of 283 wires varying in diameter from 0.065 to 0.195 in., it will be appreciated that the uniformity of physical properties secured indicate both care and precision in fabrication. We feel, however, that the prestressing must constitute the process of major benefit, for this big quantity of the largest diameter rope ever used for suspender ropes shows greater uniformity of physical properties, higher efficiency of construction and higher efficiency when bent over a sheave than any similar ropes within our experience.

First Stress		
Total Elongation in 100 Inches		
Tension in Pounds	Application	Release
32,600	0.000	0.157
40,000	0.021	0.179
60,000	0.080	0.238
80,000	0.142	0.298
100,000	0.205	0.355
120,000	0.273	0.413
140,000	0.345	0.470
160,000	0.424	0.528
180,000	0.514	0.585
200,000	0.622	0.641
205,000	0.647	

Second Stress		
Total Elongation in 100 Inches		
Tension in Pounds	Application	Release
32,600	0.000	0.152
40,000	0.020	0.173
60,000	0.079	0.235
80,000	0.135	0.294
100,000	0.193	0.354
120,000	0.250	0.413
140,000	0.309	0.471
160,000	0.369	0.530
180,000	0.430	0.588
200,000	0.494	0.646
220,000	0.605	0.704
233,000	0.738	

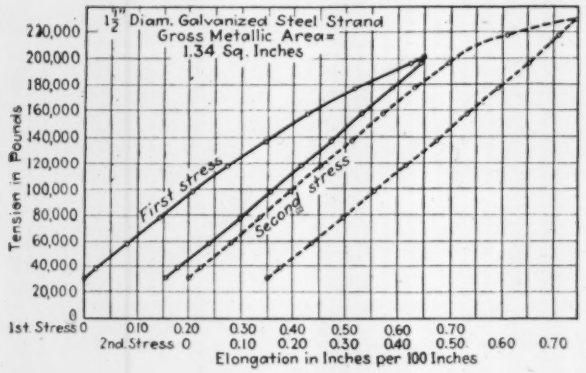


FIG. 8—THE EFFECT OF MULTIPLE STRESSING ON AN EXPERIMENTAL 1½-IN. STRAND FOR THE MAIN CABLES OF THE ST. JOHNS BRIDGE

The most recent use of this prestressing equipment has been in the manufacture of rope strands for the cables of the St. Johns bridge in Portland, Ore., a structure with a 1,207-ft. main span. In Fig. 8 is shown the beneficial effect of multiple stressing on one of these 1½-in. strands, this particular one being the first experimental strand manufactured.

The structural stretch, being confined to wire placement instead of the complex wire placement and strand seating of the rope construction, results in a more uniformly changing curve on first stressing. Due to this advantage, the prestressed strand will of course show a much higher modulus of elasticity than the rope construction. With proper fabricating machinery and prestressing the strand, a strand modulus of elasticity can be secured equal to 88 per cent of the wire modulus.

The work above described is part of the contract of the John A. Roebling's Sons Co. for the furnishing and erection of the wire cables for the Hudson River bridge, now being built by the Port of New York Authority.

Studies of Pipe Joints and Pipe Coatings

Committee Reports and Papers Before American Gas Association Present Data of Value to Water as Well as to Gas Men

PIPE joints and pipe coatings were the subject of discussion at the seventh annual meeting of the distribution section of the American Gas Association, held in St. Louis, Mo., on April 9, 10 and 11. In general, the data presented are as significant to water-works as to gas men. A condensed summary of the papers and discussion follows.

Pipe Joints

Pipe joint research and the general problem of insuring tight joints were treated in three papers read before the conference. K. R. Knapp, research engineer of the association, described the work done so far on the subject at the American Gas Association testing laboratory at Cleveland.

To date study has been confined to pipes of small size, mostly 4-in., and bell-and-spigot joints. Investigations have been divided into three subjects: old joints taken from service after failure; new joints; and general characteristics of jointing materials.

The investigation of old joints has practically been completed so far as the smaller sizes are concerned. A number of gas companies were asked to send to the laboratory samples of such old joints as had been in service for ten or more years. Approximately 30 specimens were received, ranging up to 50 years' age, the majority of which were either 4 or 6 in. in diameter.

An assembly was adopted for a transverse bending or deflection test, in which the specimen was closed at the ends by line-caps and mounted on the table of a 60,000-lb. Riehle testing machine upon two knife edges placed 5 ft. apart. The bell was placed directly under the movable head. Load was applied until a given deflection, usually ½ in., was reached. The load was noted at full deflection as well as that at which leakage began. After full deflection was secured the specimen was given a half-turn and the test repeated as before. This was done twice, so that each specimen was given four loadings in all, two in each direction. The load at which leakage occurred and the corresponding deflection, together with the load at full deflection, gave an index of the effectiveness and strength of the joint to resist transverse movement.

In general it was found that the old cement joints tested required the application of a high load to produce leakage as contrasted with the old lead joints. The load to produce the maximum deflection was also much higher with cement joints.

The most frequently used methods of repairing leaky joints are (1) remaking the joint after removing the old jointing material, (2) recalking, (3) applying leak clamps. Leakage tests made in the manner described upon remade joints gave uniformly unsatisfactory results. In addition, several unsuccessful attempts were made to effect repairs by the use of a rubber ring and cold lead strip.

No particular tests were made on the performance of recalked lead joints, as there appeared to be no reason for expecting different results from those encountered

on certain of the joints remade with cast lead and lead wool.

In the case of leak clamps the results of deflection tests on the first few joints which were so repaired indicated that this method of repair showed much greater possibilities than any other yet tried. More than twenty tests were made using leak clamps with either rubber or duck and rubber gaskets. It was found that initial tightness was much more likely to be obtained when gasket cement was used. It was also found in most cases that the plain rubber gasket gave better results than did the duck and rubber gasket.

The research work on new joints has concerned itself mostly with a determination of the effects produced on bell-and-spigot joints by the expansion and contraction caused by seasonal temperature changes. For test, joints were made short on account of the limited headroom of the testing machine. The specimens were set up in the machine in such a fashion that either direct tension or compression could be induced in the joint. Loadings corresponding to the effects of a 60 deg. temperature change were applied to the joints, alternately in tension and compression, until 25 complete reversals had been attained. Throughout the test the specimen was kept under air pressure. The joint material was purposely recessed slightly below the bell face in preparing the joint and this space was filled with water, which readily showed any leakage.

These conditions were found so severe that most of the joints failed early. The test was accordingly modified to the extent that five reversals were made under a load corresponding to a 30 deg. temperature change, followed by five more at 40 deg. and 50 deg. temperature changes respectively. A series of 25 reversals was then made under the 60 deg. temperature change. If the joint successfully stood the full range the pressure was raised in 10-lb. increments up to 50 lb. until failure occurred. All the tests were made, using a constant pressure upon the joint of 10 lb. per square inch.

On cement joints it appears that the principal strength of such a joint lies in the bond between the cement and the pipe metal; it is impossible to develop the shearing strength of the jointing material. Tests on the lead joints indicated that a very important factor in causing failure under these conditions is the roughness of the surface of the castings causing scoring of the lead during longitudinal movement. The results with machined specimens suggested the desirability of the use of smooth surfaces.

It was considered that the testing conditions were still much too severe. Accordingly, they were modified so that the test was started, as before, at 10 lb. pressure. This pressure was employed only until a failure of the joint occurred. Pressure was then reduced to 1 lb. and continued until failure took place at that pressure. It was then reduced finally to a pressure corresponding to 10 in. of water and continued to failure or until the prescribed number of reversals had been completed.

Cement joints prepared for this test were cured by being wrapped in wet burlap for two weeks. They showed performances much superior to the earlier specimens. In eight out of nine test pieces no failure at all was observed at a pressure of 10 in. of water even after 25 reversals had been used.

In a description of the pipe joint research conducted at the laboratory of the United Gas Improvement Co., H. W. Battin pointed out that those tests have paralleled the expansion and contraction tests of the American Gas Association. Tests bear out the findings of the Cleveland laboratory in that cement joints, whether neat or with mixtures of sand, are not dependable for more than ordinary low-pressure distribution.

A theory was presented as to the most frequent cause of joint failures in gas mains. It was suggested that unsatisfactory foundation conditions at time of construction allow a greater settlement at the spigot end of a length of pipe than at the bell end, where the support can be carefully prepared. The settling of the spigot end in the bell of the adjoining length causes a compression of the lead in the bottom of the joint and a void space at the top. The evidence cited on behalf of this theory is that careful records indicate that about 75 per cent of failures are found to be at the top of the joint.

This series of papers was discussed as a whole. Comment was made to the effect that experiments recently conducted in New Jersey by a manufacturer of cast-iron pipe indicate that the effect of temperature changes in the pipe on the integrity of the joint is not nearly so important as the effect of vertical or lateral ground movements. Experience in Kansas City, where natural gas is used, bear out the finding of the research committee in that leak clamps were found to be the most satisfactory method of repairing joints.

Pipe Coatings

Studies are being made on the effect of soil action on pipe-line coatings at the Bureau of Standards, with the co-operation of the American Petroleum Institute. Both mechanical and chemical actions are being investigated. It has been learned that settling of the backfill over the pipe and its subsequent shrinkage and contraction with changes in moisture content, in company with the forces of adhesion between the soil and coating, can cause distortion and disruption in bituminous coatings. It was pointed out that investigations of the chemical corrosiveness of soil must take into account both the inherent chemical nature of the soil itself and the destructiveness of the soil toward the coating being studied.

Further work is being carried out by the Bureau of Standards on the corrosive qualities of certain soils. A group of pipe lines, totaling 32 miles, in the southeastern Great Lakes district has been selected for study, some of which have been in service more than 40 years. An examination of the records of line replacements, combined with a study of the chemical characteristics of the soil at various points along the lines, indicates a close relation between soil corrosiveness and its acidity.

Water, Sewage and Refuse in Wisconsin

Nearly three-fourths of the 285 municipalities or communities in Wisconsin having public water supplies at the close of 1929 had sewerage systems also, according to records of the sanitary engineering division of the Michigan Bureau of Engineering. Of the 285 waterworks, 183 took water from deep wells, 70 from shallow wells and only 32 from surface sources. Of the 219 sewerage systems, 103 had one or more sewage-treatment works, the total number being 115. Plans for three garbage and refuse incinerators were approved by the division in 1929, to be located at Oshkosh, Racine and Whitefish Bay, and tests were made of several installations completed during the year. Charles A. Halbert is state chief engineer, and L. F. Warwick is engineer of the sanitary division.

Constructing Framed Mattress for Mississippi Revetment

Mattress Structure, Method of Fabrication and Sinking Process and Plant for Deep-Water Type of Brush Revetment Employed Largely in the Lower Delta South of the Red River

BRUSH MATTRESS originated in the early eighties as a revetment material on the Mississippi River. At the present time it is being superseded by concrete mats of blocks or slabs strung on cables so as to have flexibility. There is, however, continued use of brush mattress, and for a long time its use will probably continue for special operations where the willow growth and simpler construction procedure give it an economic advantage. In any event the brush mattress has a field of utility off the great river, where conditions are less exacting, which warrants record of the special technique of structure and fabrication which long experience on the Mississippi has greatly perfected.

The present article describes one of the two forms of structure which brush mattress on the Mississippi has taken. This form is distinctive in the feature that mattress construction may be at any place, even a hundred miles away from the bank to be protected, where the supply of materials and the conditions for fabrication are favorable. It is distinctive also because depth of water puts no serious restrictions on its placement; it is being regularly placed in New Orleans harbor where the river is 175 ft. deep.

—EDITOR.

FRAMED mattress is one of the two forms of brush revetment employed for bank protection on the Mississippi River. It has been constructed mostly in the lower delta, where its advantages for deep-water work give it preference over fascine mattress, which has to be woven where it is used. Framed mattress can be fabricated away from the bank that is being stabilized, can be towed to where it is to be used and then can be sunk in the briefest time required to place the stone ballast. Anchor and working barges, difficult to control in deep water, occupy the river only while loading and sinking are in progress. With fascine mattress the barge plant is in the river during the process of fabrication as well as while the ballast is being placed and the mat is being lowered to the river bottom. This long occupancy of the river is less a problem in the shallower water of the upper delta, where anchorage is comparatively easy and where fascine mattress has the greatest use.

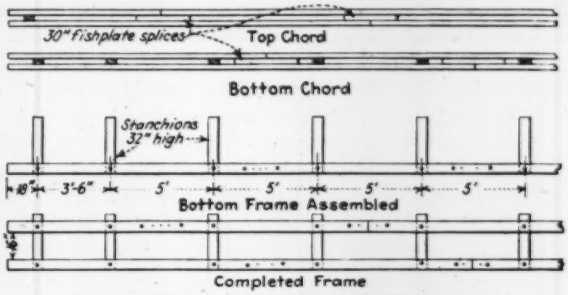


FIG. 1—FRAMES FOR HOLDING BRUSH IN FRAMED MATTRESS

The structure and fabrication of framed mattress revetment have been greatly improved during the long period of its use. These are the subject of this article, for which sketches and photographs were secured in the field during visits to operations in progress in 1929 in the New Orleans River District. In a following article fascine mattress will be described from data obtained by a similar field study.

Mattress Structure and Materials

A framed mattress consists of three layers of willows (the middle layer at right angles to the two others) compressed between top and bottom frames of timber. The mattress is fabricated in regular sections 100x150 ft., and in special sections shaped to correspond with bank contour and other requirements of individual locations. Each section is stiffened for launching and towing by lines of pole girders laid across the top-frame chords and securely wired and nailed to them. The structure is shown by Figs. 1, 2 and 5 and by several of the views of the page group of illustrations, Fig. 3.

The mattress materials, except brush, are of ordinary kinds. The frame lumber is yellow pine of the quality

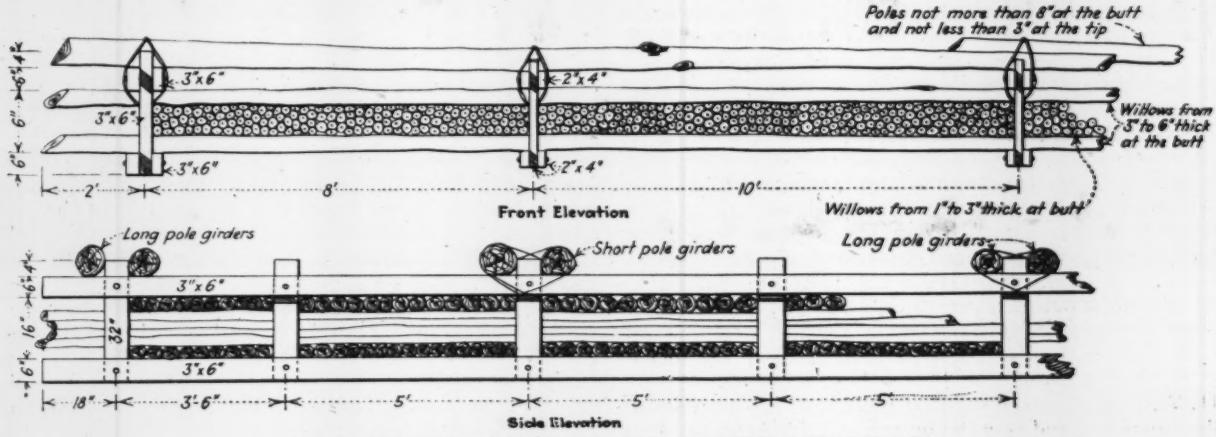


FIG. 2—SECTIONS SHOWING FRAMED MATTRESS STRUCTURE

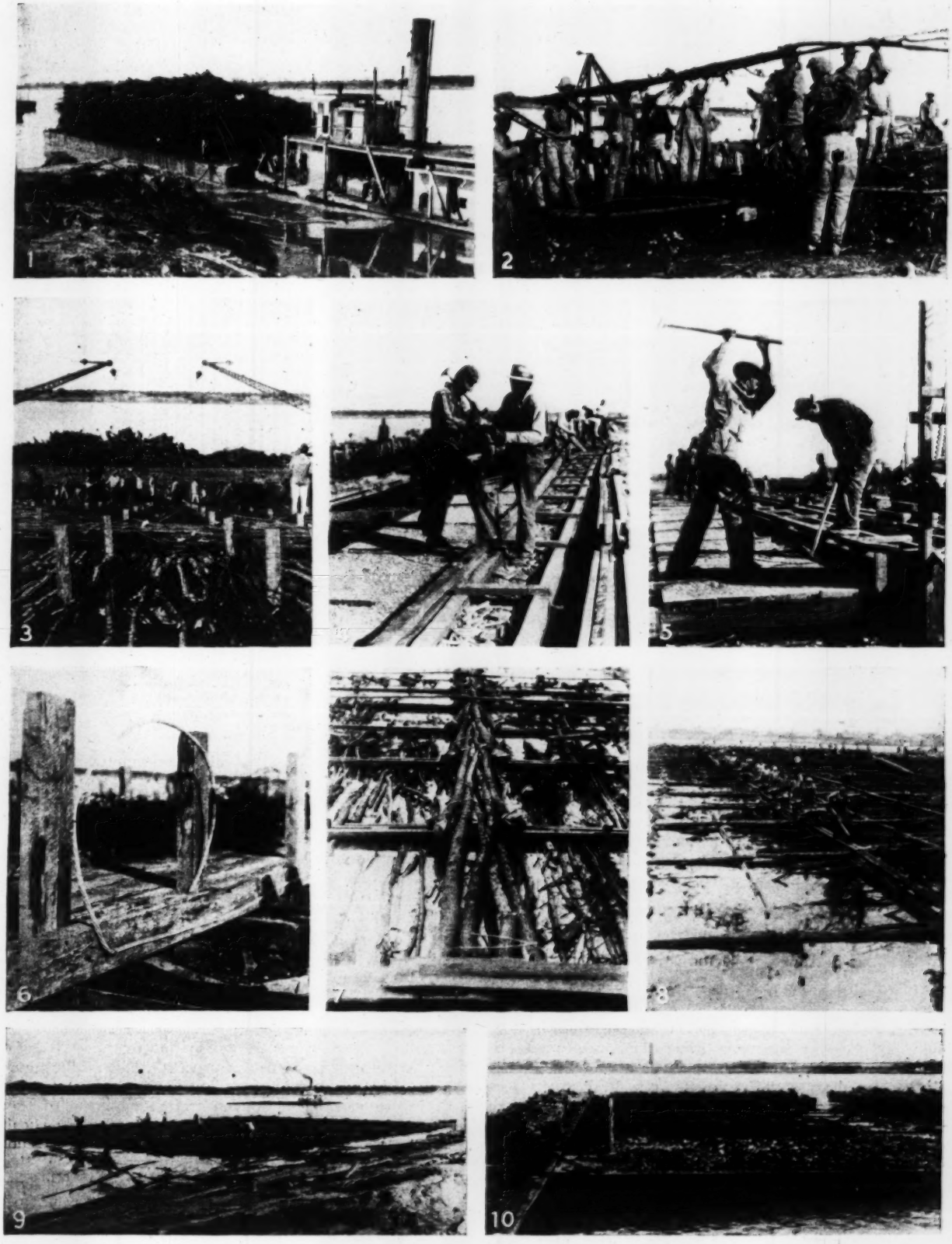


FIG. 3—VIEWS SHOWING MATTRESS CONSTRUCTION AND SINKING PROCEDURE

(1) Brush barge landing at fabricating plant. (2) Handling willow brush into mattress. (3) Mattress weaving, showing frames and brush layers. (4) Boring chord timbers for treenails. (5) Spiking assembled chord members. (6) Cable stapled to frame for splicing mattress sections. (7) Stiffening girders of poles wired and spiked to frame caps. (8) Placing stone ballast for sinking mattress. (9) Finishing launched mattress section. (10) Mattress in sinking position between lowering barges.

known as No. 2 common; the cable ties are ordinary galvanized steel. The brush used is bank and bar willow from 3 in. to 6 in. in butt diameter. The whole tree is used and generally the minimum length is specified as 20 ft. Within reasonable limits selection is confined to full-branched and shapely trees; as willow growth has become used up, however, the range of selection has been increased. No willows that have been cut more than 90 days are used; this wood, while remarkably flexible when green, grows brittle with age, even when submerged. This age limit is held important also in selecting the poles for the mattress stiffeners. They have to be live and straight and at least 22 ft. long, with 5- to 8-in. butts and 3-in. tips. These poles are trimmed clean.

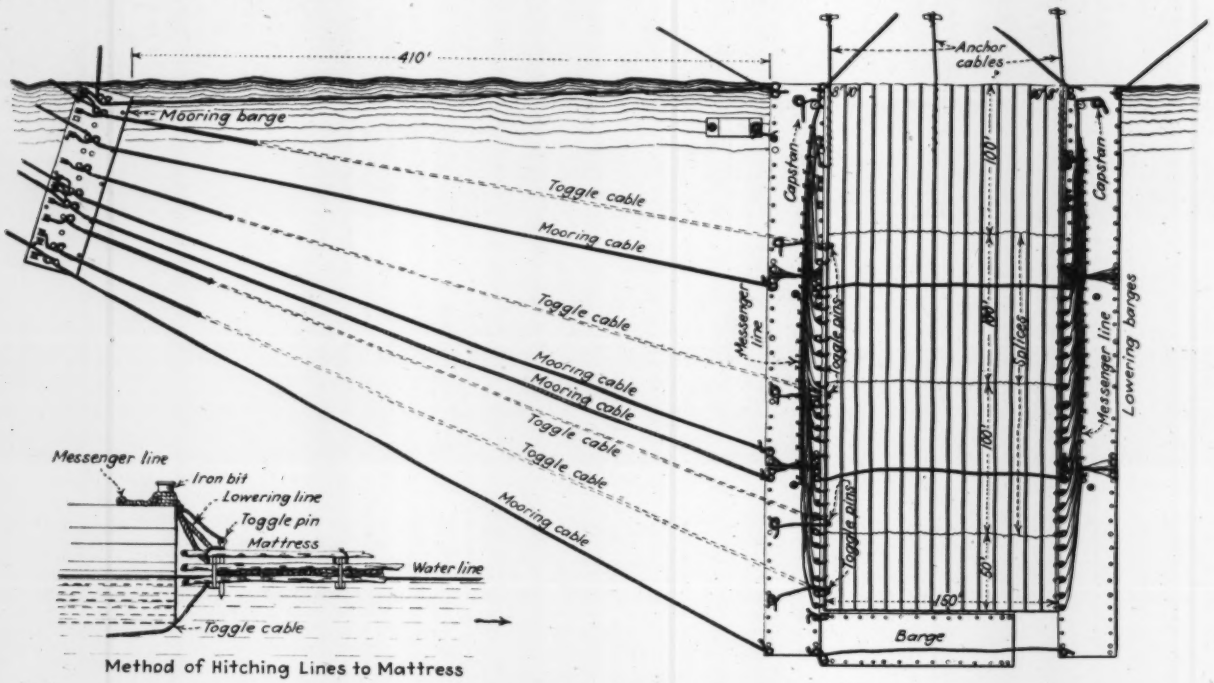


FIG. 4—ARRANGEMENT OF MATTRESS-SINKING PLANT

Mattress Fabrication

Construction of framed mattress is at the willow bank or bar, the theory of production being to make the long haul with the finished mattress and the short haul with the raw material. A single trip with mattress sections in tow is equivalent to many trips with brush barges. The brush barges shown in Fig. 3 ordinarily have no place in the fabrication of framed mattress. In this particular operation the willow bank had been about cleaned up, and for the few remaining mattresses to be produced it was less costly to import willows than to move the plant to another willow bank. Such occasions are multiplying as the willow growths are being cut down.

The first requirement of location for a framed-mattress operation is a willow bank or bar that will supply the volume of brush required for the revetment being constructed. It is better for towing operations if this bank is located upstream from the revetment. The next requirement is a sloping bank of about 1 on 7, with a depth of water and current conditions which are not unfavorable to bringing in and mooring barges and for the launching and finishing of mattress sections. The offshore working conditions are as important as those on shore. These latter, except the requirement for a good bank slope, are largely those that affect willow cutting and hauling, such as dry or swampy terrain. Camp accommodations are supplied by quarter-boats. Haulage is by mule teams and wagons and is usually continuous with the weaving process; cutting is by hand and is also continuous with the weaving. There is virtually no stocking of willows beyond that necessary to maintain a reasonable leeway over consumption.

The mattress is fabricated on launching ways. These are lines of timber extending down the sloping bank into the water far enough to give depth for launching. The bank of ways is wide enough for a 100-ft. mattress and extends upbank far enough to provide 150 ft. for the mattress and additional footage for a framing platform for the mattress frames. The ways are supported as simply as may be in the ground by stakes; construction is solid enough to provide a stable working platform, but it is always kept in mind that it is temporary construction.

Frame Construction—Building the mattress framework is the first construction process. This framework, which holds the mat of willows, consists, for each 100x150-ft. section, of sixteen frames made up of top and bottom chords and a web system of vertical stanchions as shown by Fig. 1. The frames extend across the 100-ft. width of the mattress; those at the river and the shore ends of the mattress are built of 3x6-in. timber and the fourteen intermediate frames of 2x4-in. timber. The frame and stanchion spacing are shown by Fig. 2.

All framing is done on a platform at the upper end of the ways; views 3 and 4 in the page group, Fig. 3, show framing operation. The usual procedure is to string end to end on the platform and flat side down

the timbers (3x6-in. or 2x4-in.) making up one member of the two-member bottom chord. On this string of timbers the joint splices are laid and the stanchions are spaced. Over splices and stanchions are strung the timber of the second chord member so as to break joints with the timbers of the first chord member. Chord members, splices and stanchions are then nailed through at each splice with four wire nails and two treenails and a wire nail and a treenail at each stanchion. There the frame is turned over and back-nailed with two wire nails at each splice. The final step is to staple

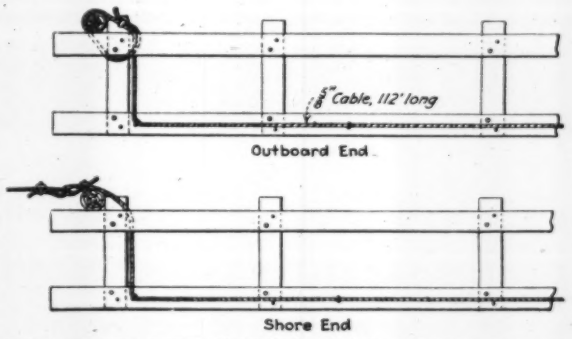


FIG. 5—WIRE ROPE FASTENINGS AT MATTRESS EDGES

a wire rope to the side of each bottom chord as shown by Fig. 5 and view 6 on the page group, Fig. 3. These cables serve in splicing mattress sections to one another, but more particularly to bind the mattress from edge to edge and prevent the outboard end from breaking off and separating from the other part. The top chord is framed exactly like the bottom chord, except that it has no stanchions.

Brush Filling—With the sixteen bottom frames for a mattress section located on the ways, the brush filling begins by placing a layer of 3- to 6-in. willows across the bottom frame chords, as shown by Fig. 2. The procedure is particular in its details, because this bottom layer is the floor of the mattress and carries the brush filling and stiffens the structure laterally. Beginning at the head frame at the bottom of the ways, the willows are laid with the butts projecting 2 ft. beyond the frame. The purpose of this overlap is to prevent butt-splitting and to give a rigid mattress edge for towing and sinking. As the willows are laid they are spiked through their trunks to the chords of the bottom frames. With the first strake of willows laid across the mattress and nailed, a second strake is begun with the butts aligned on the third frame. These are spiked and a third strake is begun, dropping back three frames. This process is continued until the tails of the willows in the strake being laid overlap the tail frame. Then the final strake is laid with the willows reversed so that the butts overlap the tail frame 2 ft. This completes the floor.

The filling willows which are laid on the floor are smaller (under 3-in. butts) and are more brushy, and are laid at right angles to the floor willows. They are laid to a depth that, when the top layer parallel to the floor layer has been added and the mattress has been compressed by jacking down the frame caps, the mat of brush will be 16 in. thick. The top or cover layer is the duplicate of the floor layer in arrangement and size of willows. The next operation is to jack down and fasten the frame caps. The jacks straddle the stanchions and bear on the cap, taking hold of the stanchions for purchase by means of hooks similar to ice tongs. A wire nail and a treenail at each stanchion fasten the caps to the stanchions.

Generally the mattress is launched before placing the pole girders and performing the other finishing operations. These operations can be done as well with the mattress afloat, and meanwhile the ways are cleared for fabricating a succeeding mattress section. As shown by Fig. 2, the pole girders are placed across the frame caps at intervals of 20 ft. and at each long edge of the mattress section. Each line of poles is spiked and wire-tied at its intersections with the caps, except the edge poles, which are left unfastened until adjacent sections are spliced on. Between these long girders are twin poles, which reach from each end of the mattress section to the third cross-frame. These pole lines, besides stiffening the mattress, partition it into surface pockets 10 to 12 in. deep, in which the ballast is retained when sinking the mattress on a steep bank.

As the description indicates, mattress construction is a manual operation. Willow cutting, loading, unloading and placing in the mattress—everything except team hauling—is handwork. The framing is handwork. The only equipment is carpenter tools and the compression jacks.

Mattress Sinking

The mattress sections are coupled up in tows of ten to twelve sections for moving downstream and in tows of two to three sections for moving upstream. When at the bank to be revetted, the sections are spotted, anchored and spliced according to the requirements of the location. A mattress-sinking layout is shown by Fig. 4. It is to be noted that the sections are placed with their long sides parallel to the shore and the wooden frames therefore normal to the shore.

Splicing and anchoring the mattress sections are the first operations. In splicing, the caps of the abutting frames are connected by a double fishplate of 11-ft. timbers. The stiffening poles along the edges are then spiked to the caps and the free ends of the wire cables are lapped across the joint and fastened by clips. The ends of the sections are meanwhile tied up, or anchored, to the barges as shown by Fig. 4. This anchorage consists first of a system of lowering ropes with a bight around the end-frame caps. The ropes are carried up and

FIG. 6—JACKS FOR COMPRESSING MATTRESS
These jacks grip the vertical stanchions with tongs like ice tongs and bear down on cap timbers.

around bits on the barges and then to fastenings with a messenger line to a capstan which takes a strain on all the lines. The second element of the anchoring system consists of toggle cables running from the mooring barge under the upstream lowering barges to toggle pins through the mattress. The ends of the toggle cables carry eyes to engage the pins; from eyes in the tops of the pins ropes run back onto the barges and serve when the mattress is sunk to recover the pins and release the toggle cables. The cable system is not essentially complex, but it calls for careful rope laying and nice management in lowering the mattress evenly and under control.

To sink the mattress it is loaded with 10- to 100-lb. stones, 70 per cent of the stones ranging from 25 to 75 lb. About half of the stone is placed from a barge at the outer end of the mattress and half from a barge tied up alongside the shore end of the line of downstream lowering barges. Plank runways run from the stone barge out onto the mattress in a return loop, and men with barrows load the stone by hand, wheel it out onto the runway and side-dump it onto the mattress. The wheelers load their barrows all at once and wheel them out onto the mattress in procession, and in procession return and load again. With good foremen the operation is almost clocklike in its regularity. It takes about 9 lb. of stone per square foot to sink the mattress. An additional 7 lb. of stone is cast in the mattress after it is sunk.

A full revetment is usually 350 to 400 ft. wide. Sinking is begun at the downstream end. When a section (150 ft. along shore) is sunk, the lowering barge plant is pulled 140 ft. upstream. This permits the next section of mattress to be sunk so as to overlap the preceding section 10 ft. This procedure is repeated until the revetment is completed to full length. The river or outboard end of a mattress section is shown by Fig. 5; as shown in the same illustration, the shore end is arranged for anchorage to the shore. The upper bank paving is concrete.

Location and Personnel

The mattress making and sinking operations on which this description of practice has been based are located in the New Orleans River District, Major W. H. Holcombe, Corps of Engineers, district engineer, and Capt. Helmer Swenholt, Corps of Engineers, chief, Fourth Area, in direct charge.

Repair of Damaged Bascule Leaf at Rochester, N. Y.

Forged-Steel Counterweight Hangers on Stutson St. Structure Replace Defective Cast-Steel Hangers Which Failed While 90-Ft. Leaf Was Opening

By William H. Roberts

Assistant Engineer, Department of Public Works, Rochester, N. Y.

THE Stutson St. bridge in Rochester, N. Y., has been reopened to traffic after the repair of the west leaf of the bascule span following its collapse on Jan. 11, 1930, while being opened to pass a car ferry. The cause of the collapse has been fixed in the cast-steel hangers, which broke away from the counterweight trunnion pins, dropping the 270-ton concrete block into the river back of the main trunnion pier. The steel castings showed numerous blowholes, and several large crystals were exposed where they broke. One of these castings showed imperfect structure up to almost 50 per cent of its area.

Examination of the failed structure also revealed that the south trunnion pin was badly scored; it had never been greased, inasmuch as the hole from the grease cup had not been drilled through the bronze bushing around the pin. The north trunnion pin was also slightly scored, although it had normal greasing facilities—namely, a hole drilled to the inside of the bearing which was channeled to distribute the grease from cups. Inasmuch as the counterweight in falling moved north, it has been assumed that the south hanger broke first.

The over-all length of the Stutson St. bridge is approximately 883 ft., involving a simple truss spanning railroad tracks along the west bank of the river, a double-leaf underslung-counterweight bascule span, 180 ft. center to center of main trunnions over the Genesee River, and a long steel viaduct approach on the east bank. The bridge was designed by the Strauss Engineering Corporation, of Chicago, in 1914 and was constructed for the county of Monroe during the following two years. The territory was later annexed to the city and the bridge has always been carefully inspected and maintained by city forces. It has a 24½-ft. roadway and two 5½-ft. sidewalks. When closed, it has a height above average water

FIG. 1—RECONSTRUCTING BASCULE LEAF AT ROCHESTER, WHICH COLLAPSED WHEN HANGER CASTINGS FAILED
Left—New steel and new counterweight in place. Work under way on replacing the flooring. Center—New counterweight before supporting forms had been removed. Note the new steel hanger forging just beneath the diagonal member to the left. Right—New counterweight and steelwork completed with leaf almost ready to be lowered.

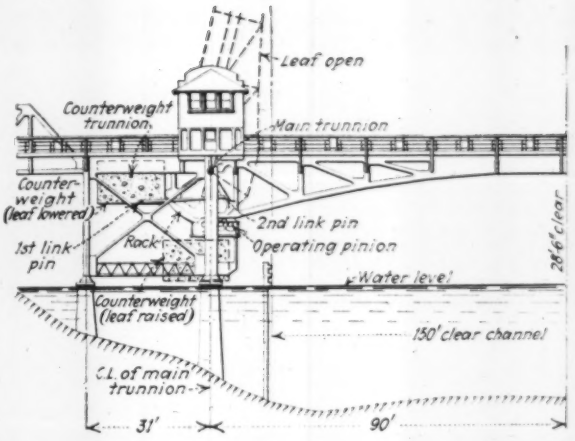


FIG. 2—ELEVATION OF WEST LEAF, STUTSON ST. BRIDGE, ROCHESTER, N. Y.

level of 28 ft. The leaves are counterbalanced by underslung counterweights supported in a horizontal position by trunnion bearings and I-beam links.

At the time of the failure, when the west leaf dropped about 10 ft., jamming past the center and twisting about 1 ft. north, the inside vertical columns of the trunnion posts were badly damaged, as were also the beams supporting the motor housings on each side of the bridge. Since river traffic was blocked until the bridge could be opened, work was rushed day and night for ten days.

The first operation in repairing the bridge was to remove the four end panels of the west leaf so that the remaining portion of the leaf could be jacked up off the main trunnion bearings and the inside trunnion posts replaced with new ones. The dismantled leaf was then raised to its full height by means of a hoisting engine and cables, where it was tied in an upright position and blocked with 12x12 timbers at each bumper. The third operation was the construction of a new counterweight, including a new steel frame attached to the truss by means of forged steel counterweight hangers. About 124 cu.yd. of concrete was necessary, poured in the proportion of 1:3.32:4.41 and using high-early-strength cement.

The final repair operation consisted of replacing the four end panels of steel and restoring the wood floor and sidewalks. It was also necessary to rewind both motors, which were burned out when the bridge dropped. Thus, repair work required the following items: steel forgings for counterweight hangers, two inside vertical columns, two I-beams at motor housings, two steady arms or links on the counterweight, two outside diagonals, all of the steel and steel reinforcement within the counterweight, and all gusset plates and incidental connections.

It is also planned to replace the present cast-steel counterweight hangers on the east leaf with steel forgings similar to those used on the west leaf, and to install on both leaves a modern high-pressure greasing system.

The bridge was restored by the Genesee Bridge Co., Rochester, N. Y., under the direction of Harold W. Baker, commissioner of public works.

Precautions Recommended for Concrete in Alkali Soils

THE report of a committee of the American Concrete Institute on the disintegration of concrete (G. H. Williams, professor of civil engineering, University of Saskatchewan, Sask., Canada, chairman), which was published in the November *Journal* of that society, gives a historical review of the various studies which have been made to determine the causes of concrete disintegration, with special reference to concrete in alkali soil. In the words of the committee, "Observance of the following precautions in the selection of materials and in the preparation and curing will tend to result in a concrete of highest resistance to sulphate action."

1. Select a portland cement which has a high natural resistance as measured by preliminary tests.

2. Select a sound, durable well-graded aggregate combined to result in the highest weight per cubic foot.

3. Resistance varies with cement content up to mixtures approaching neat cement; therefore use a rich mix.

4. Use as little mixing water as will result in a plastic mushy consistency preferably with a slump not greater than 3 to 5 in. depending upon the conditions of the work. Place concrete in the dry and remove excess water or laitance. Reduction in water content of successive batches under such conditions to prevent formation of excess water or laitance is to be preferred.

5. For large structures, cast in place, cure concrete under moist conditions for as long a period as possible and allow the concrete mass to dry and harden in air before allowing alkali groundwater to come into contact.

7. Concrete products and precast structural members should be cured in steam above 100 deg. C. Lower temperatures will be injurious.

8. Backfill portions below ground level with gravel or crushed stone and provide drains outside and below the lowest portion of the structure wherever practicable.

9. Where thorough drainage cannot be obtained, place bituminous membrane waterproofing continuously below and up the sides of footings and continue the waterproofing to the ground line on the outside. Bituminous paint coats cannot be considered efficient waterproofing.

10. Observing the foregoing precautions as to materials and mix for any given cement and aggregate, (*a*) concrete of highest impermeability will probably be most resistant, and (*b*) generally the concrete of highest strength will be least permeable.

Highway Accidents in Indiana

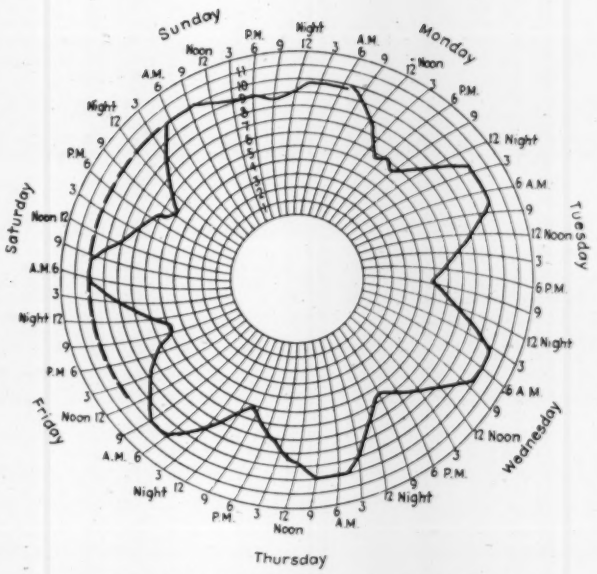
Obstructed view was responsible for 149 out of a total of 788 highway accidents in Indiana during 1929, according to a report by A. H. Hinkle, superintendent of maintenance, Indiana state highway commission. Crops at corners and road intersections, shrubbery, trees, embankments, buildings too close to the right-of-way, as well as fog, smoke and dust, are all sources of accidents. Fixed objects struck by vehicles include, in order of number of accidents: deep side ditches, utility poles, bridges, culvert headwalls and trees. Such accidents can be reduced only by greater side clearances, and the report recommends that the side ditches be eliminated, bridges and culverts made wider, and poles put as far from the center of the road as is practicable. No less than nineteen bridges were wrecked by speeding motor cars. Accidents at 39 railroad crossings (fourteen steam and five electric) caused nineteen deaths, and at seven of these crossings warning was given by automatic signals. In the total of 788 accidents, 172 persons were killed and 722 were injured; among these pedestrians numbered 27 and 17 respectively.

Small Siphon Spillway Serves City Distribution Reservoir

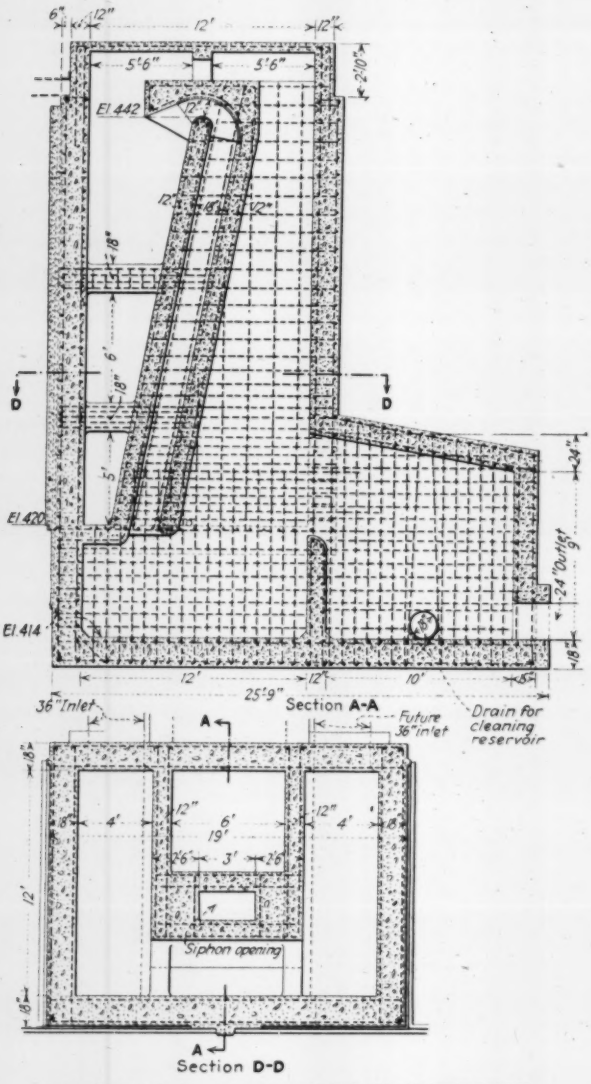
Automatic Control and Small Space Required Were Governing Factors in Selection— Double Stilling Well Used

By J. R. Grant
Consulting Engineer, Vancouver, B. C.

A SMALL siphon spillway of compact design was recently built to discharge the overflow from the Vancouver Heights distributing reservoir which is being constructed in units by the Greater Vancouver Water District at Vancouver, B. C. At present the spillway is used in connection with the first unit already completed, but additional units, which will give an ultimate capacity of 46,000,000 Imp. gal., will be built to utilize the same spillway. The outlet structure is located at the side of the reservoir at a point where a partition wall will divide the completed reservoir into two sections, of one-third and two-thirds the total capacity, so that the spillway will be common to both sections. The reservoir is situated in a residential district about 345 ft. above and 1,600 ft. back from the shore line of Burrard Inlet.



RECORD OF WATER LEVEL MAINTAINED BY SIPHON SPILLWAY
Heavy dotted line represents elevation lip of siphon. Note that the height was never exceeded.



SECTIONAL PLAN AND ELEVATION THROUGH SIPHON SPILLWAY

The siphon design was based on calculations, but a check on its characteristics and capacity was secured by means of a quarter-size test model tested at the University of British Columbia. This model checked the calculated discharge capacity and also proved that the addition of a baffle wall and a second well made the discharge more uniform and the resulting vibration less. The success of the siphon in maintaining the water level at a predetermined height is indicated by the accompanying record of a week's operation.

The siphon spillway was selected to provide discharge for the 100 sec.-ft. of overflow because it furnishes automatic regulation, together with a minimum size of outlet structure. An overflow weir would have been excessively long and the falling water would have entrapped a large amount of air, which might have made the discharge into Burrard Inlet objectionable to small pleasure boats.

The throat of the siphon provides a reservoir depth of 22 ft. and the discharge passes down an inclined lower leg of 3x½-ft. cross-section. The inclination of the lower leg, in addition to providing rapid action by quick sealing, makes possible a more compact outlet structure. The siphon discharges into a stilling well, from which the water flows over a baffle wall into a second well that connects with the 24-in. outlet pipe as shown in the accompanying drawing. The addition of the baffle wall and second well assists in stilling the discharge, and the roof of the latter slopes to facilitate the escape of entrapped air. The outlet pipe has a fall of 320 ft. in a length of 1,600 ft., which is sufficient to take care of the flow from the two 36-in. inlet pipes under their operating head.

The unit of the Vancouver Heights reservoir already completed was built under the direction of E. A. Cleveland, chief commissioner, Greater Vancouver Water Board. The George Snider Construction Co. was the contractor. The writer acted in the capacity of designing engineer for the water board.

Beam Connection Tests Discussed at Welding Meeting

Annual Convention of American Welding Society Held in New York City, April 23-25—Structural Steel Welding Committee Progress Report Reveals Gratifying Results, With Investigation 80 Per Cent Complete

STRUCTURAL matters discussed at the annual meeting of the American Welding Society held in New York City April 23-25 centered on the subject of beam connections, with particular reference to the related questions of continuity and flexible joints. There was also presented a paper developing in detail a theory of stress distribution and transfer in welds. E. A. Doyle, consulting engineer, Linde Air Products Co., was elected president and Frank P. McKibben, consulting engineer, General Electric Co. was elected senior vice-president. C. A. McCune, director of research, American Chain Co., was re-elected treasurer.

One of the most important items on the program was the progress report of the structural steel welding committee, made by James H. Edwards, chief engineer, American Bridge Co., chairman. Mr. Edwards reported very gratifying progress on the extensive investigation which was started several years ago to determine what could be expected of welded joints made in accordance with planned procedure control, including qualification tests for the welders, but fabricated in widely separated structural steel shops. The test program included 1,677 specimens involving 57 joints of 191 different sizes. The fabrication of these specimens was divided among approximately 40 structural steel fabricating shops throughout the United States, and to date 80 per cent of these specimens have been made and tested. Work is under way on 10 per cent, and plans for the remaining 10 per cent are somewhat indefinite. The welders making these joints were of ordinary ability but all were qualified in accordance with a procedure control drawn up by the committee, requiring that specimens made by the welders should average 45,000 lb. per square inch in the weld metal. In the tests so far made the welders who qualified have produced average weld metal strengths of 54,020 lb. per square inch.

Mr. Edwards showed a series of slides giving the charts upon which the test data are being plotted. Results from the widely separated structural shops on the different sized welds and various types of joints are so nearly the same when reduced to a unit strength basis of pounds per linear inch of weld that the concentration of plotted points resembles a solid black blot on the charts. No marked difference in the results from gas- and arc-welded specimens is noticeable. Such remarkable uniformity is, in the opinion of Mr. Edwards and of various members who discussed the subject, due almost entirely to the qualification test.

Where there was no eccentricity there was very little deformation of the plates at failure. The results also showed that the plate thickness has little effect on the strength. Butt welds showed more variability than fillet welds. In the discussion, H. L. Whittemore, of the Bureau of Standards, urged a wider use of qualification tests in actual practice and pointed out the insurance and advertising value that would be inherent in qualification certificates.

In a paper presented by Leon C. Bibber, senior welding engineer, bureau of construction and repair, Navy Department, a theory of stress distribution and transfer in welds was developed. The paper was important as representing almost the first published attempt to theorize on welding, most of the literature so far dealing with practice. The paper was also gratifying in that the theory presented substantiated existing empirical knowledge, without being in any way bent to fit it. Only fillet welds were considered, although the theory embraces all kinds of welds. In developing the theory a theoretical weld (exact geometrical shape with no penetration) was considered first and then the results were adjusted to conform with actual welds, using an assumed penetration of $\frac{1}{8}$ in.

Some of the conclusions reached with the aid of the theory in so far as tension and compression are concerned are as follows: (1) The legs of a fillet weld in tension are subjected to combined shear and tension, while the force in the throat is pure tension. (2) The stress in the throat of a theoretical full fillet weld in tension is exactly twice the stress in the base metal. (3) The combined stress from shear and tension in the legs of a fillet weld in tension equals 1.618 times the stress in the base metal. (4) In a theoretical 45-deg. fillet weld the legs are capable of being somewhat stronger than the throat. (5) In welds with angles other than 45 deg., the maximum efficiency of the parallel leg (leg parallel to direction of force) drops rapidly from infinity at a 0-deg. angle to zero at a 90-deg. angle, and below 60 deg. it exceeds that of the throat. (6) The efficiency of the transverse leg exceeds the throat at angles above 50 deg. and equals that of the parallel leg at an angle of 45 deg. (7) Full benefit from reinforcement cannot be obtained with theoretical fillet welds. (8) In lap joints, a width of lap of about five or six plate thicknesses is a good practical lap. (9) Not obtaining metal-to-metal contact between the faying surfaces of fillet welds does not influence the strength of the weld. This is not true in a lap joint. (10) The increased strength of an actual weld ($\frac{1}{8}$-in. penetration) over a theoretical one can be considered 20 per cent. (11) In tension the 45-deg. fillet weld is the simplest, most efficient and most economical form of fillet weld.

In applying the theory to fillet welds in compression, the following conclusions were drawn: (1) Conditions for compression are the exact opposite of those in tension, and therefore the throat of a fillet weld in compression is under pure compression and this stress is exactly twice that in the base metal. The legs are under combined shear and compression. The principal or combined stress is 1.618 times the stress in the base metal. (2) In compression there is no bond; the full strength of the weld metal would be developed if there were no connection between the base metal and the weld metal, and therefore a mean value to apply to the legs as a whole will depend upon the values of the weld metal in compression and the bond in the shear. Also, this mean value will depend upon the ratio of the areas

in shear to those in compression; for the 45-deg. fillet, the areas are equal. (3) Reinforcement of fillet welds in compression is of value. (4) A fillet-welded lap joint should not be used as a compression member unless the joint is so stiffened that it cannot move out of line. (5) Absence of metal-to-metal contact between the faying surfaces has no effect on the strength of a fillet-welded joint in compression. (6) The increase in strength of an actual weld over a theoretical weld in compression can be taken as about 50 per cent.

Flexible or Rigid Connections?

Two series of tests were reported bearing on the important subject of flexibility and rigidity in beam-to-column connections. One series was made at Lehigh University and reported by Eugene H. Uhler and Cyril D. Jensen, and the other at the laboratories of the Westinghouse Electric & Manufacturing Co. and reported by Charles H. Jennings and H. H. Jakkula.

In the Lehigh tests 8-in. 17.5-lb. I-beams were used with 8-in. 58-lb. H-section columns. Five web welds and two flange welds were used, the beams and columns being connected directly without recourse to clip angles. Each web weld consisted of a pair of fillets, each fillet disposed symmetrically about the center line of the beam and ranging in length from 2 to 8 in. in the several types. The two flange connections had welds placed top and bottom of the beams. All welds, with the exception of one flange weld, which was $\frac{3}{8}$ in., were $\frac{1}{4}$ in. This small size of weld was used in order to minimize as much as possible any effect upon the results that bending in the web of the beam might produce. Frame tests—a beam framed between two columns—and cantilever beam tests were made. The purpose of the former was to determine bending stresses in the welds and negative bending moments in the beams. Because it was not practicable or desirable to test the frames to destruction the cantilever beams were included, to be tested to failure to determine ultimate loads and factors of safety.

In the frame tests, two lengths of beam spans, 9 and 12 ft., were used. Although short columns were necessary to permit entering the frames in the testing machine, the condition pertaining when long slender columns are used was approximated by an apparatus permitting the columns to be inclined computed amounts. By this means results were obtained for columns zero, 6 and 12 ft. long. Bending moment diagrams were determined and each was plotted with the diagram of a simple beam and of a fixed beam. The position of the test beam diagram between the two others plainly indicated the relative rigidity or flexibility. Conclusions are as follows:

1. In every test where beams were welded to the column along the web of the I-beams, high stresses were developed in the weld under working loads.

2. The indicated factor of safety for web-welded connections with working loads on the beam ranged from 0.3 to 3.2. Even the higher of these values is not believed to be high enough for practice.

3. The few tests made on web-welded connections where the lower flanges of the beams were in contact with the face of the columns indicated an increased rigidity of the joint and at the same time reduced maximum stresses in the weld.

4. Flange-welded connections give nearly full rigidity of joints. Full negative moment should be used in the design of such joints.

The Westinghouse investigation was similar to that at Lehigh in that the question studied was the strength of flexible connections. On the other hand, in this investigation rigidity of the various joints was indicated by plotting the end slopes of the beams against the bending moments, and in cantilever beam tests especially the relative stiffness of the connections was plainly evident. Tests were made using 8-in. 18.4-lb. I-beams framing between 8-in. 34.3-lb. H-section columns. Similar members were used in double-cantilever beam tests, in which the beams were welded to either side of the column. This arrangement made a symmetrical specimen and produced in effect a connection between a beam and a rigid column.

Four types of joints were used, all being web connections and requiring two $\frac{1}{4}$-in. beads each 2.66 in. long. In the first type of joint the beam was welded directly against the column, the bead being disposed symmetrically about the center line of the beam. In the three other joints web angles were used. Type 2 had the bead along the vertical edge of the outstanding leg. In type 3 half of the bead (1.33 in.) was on the vertical edge and the other half along the top edge—that is, the upper corners of the outstanding legs were welded to the column. Type 4 was the same as type 2 except that $\frac{1}{16}$-in. clearance was provided between the angle and the column.

The results obtained from the various tests can be briefly summarized as follows:

1. The results from the beam tests on the type 2 and type 3 connections indicated that whenever angles are used in connections to produce flexibility, welding should never be placed on the sides of the flexible leg of the angle.

2. The most flexible joint was obtained by the type 4 connection, where a small clearance was left between the side angles and the supporting columns.

3. The safety of a connection made by welding a beam web directly to a column lies in the fact that the critical section of the weld is larger than the section of the beam web to which the weld joins. Connections of this type might be satisfactory for static loads but should never be used for dynamic loads.

4. The method of testing connections by means of double-cantilever specimens furnishes valuable information as to joint flexibility. In these tests, joints of types 1 and 3 proved unsuitable, type 4 was the best for a flexible connection and type 2 was suitable but not markedly efficient.

5. The data obtained from double-cantilever specimen tests can be used as a means of designing beams and connections.

With regard to the last conclusion, the authors emphasized the possibility of using bending moment-end slope curves in designing beams of any span and loading. For a uniformly loaded beam, the authors of the paper presented the following formula:

$$M = \frac{Kql^3}{12\,(2EI + K)}$$

where M is the bending moment on the connection, l is the beam span in inches, q is the unit load on the beam in pounds, K is an experimental constant obtained from the bending moment-end slope curve of the type of connection being considered. Then, since the bending moment to cause yielding is known from the tests, comparison of this with the computed bending moment will show whether or not the beam connection is safe. If the stress distribution in the connection is known, the equation can be expressed in terms of stress rather than of bending moment.

Water Purification Plant of Kobe, Japan

Water Supply and Sewerage of Large Japanese Cities

Up-to-Date Occidental Methods Followed — Slow-Sand Giving Way to Rapid Water Filters and Activated-Sludge Sewage Treatment Being Used on a Large Scale

By Harold E. Babbitt

Professor of Sanitary Engineering, University of Illinois, Urbana, Ill.

Sanitary Forwardness of the Japanese shown in the second article written on Professor Babbitt's travel in the Far East is in striking contrast to his observations along the Chinese seaboard, printed in our issue of March 20, p. 484. In a later issue sanitary engineering and public health in Manila will be considered. —Editor.

THE ideals of water purification and the collection and disposal of sewage in the larger cities of Japan are on a par with those in the most progressive cities of the Occident. In most of the larger cities of Japan the ideals, with respect to the quality of the public water supply, have been met for years. For the collection and disposal of sewage, the ideals have not yet been attained in all cities, but works are now being operated, are under construction or are contemplated which will attain these ideals in the larger cities in the near future. All forms of sanitation in Japan are receiving the attention which their relative importance in connection with the life of the people and the economic situation justifies. The Japanese people are progressive and are rapidly securing the various works essential to the development and maintenance of clean, healthful municipalities.

Osaka—Japan's largest city, Osaka, has a population of 2,408,000. Its water supply is taken from the river at the Kunishima plant at a point about 20 miles below the outlet of the sewers of Kyoto, an industrial city with a population of 755,000. Between Kyoto and Osaka there are a few small villages which discharge sewage into the river. The pollution of the river water at the Osaka water-works intake is not extreme, but to relieve the load on the filters plans are now under way for moving the water-works intake to a point above Kyoto.

Low-lift pumps deliver the river water to settling basins, in which, after receiving a small dose of alum, it is retained from two to six hours, depending on the quality of the raw water. The water is then passed through 24 slow sand filters, each about 200x200 ft., operated at a rate of some 4,000,000 gal. per acre per day (4 m.g.d.) —12 ft. per day, as the Japanese express it. The clear-water basins have a total capacity of 33 m.g. The nominal capacity of the slow sand filter plant is 75 m.g.d.; a supplementary 30-m.g.d. rapid sand filter plant is now under construction by the Pittsburgh Filter Co. The quality of the water is excellent and the aim is to equal or exceed the standard of quality recommended by the U. S. Public Health Service. Water is supplied to a large percentage of the houses in the city.

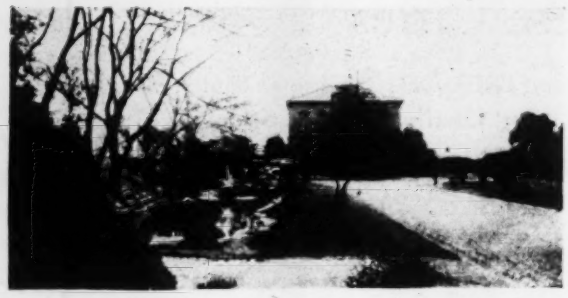
A comprehensive system of sewers to serve all but the outlying districts of Osaka is more than 50 per cent completed. All sewage is now discharged into canals or arms of the river which intersect the city, but complete sewage treatment is planned. The city will be divided into three sewerage districts, each with an activated-sludge plant. A working-scale experimental plant of that type, using diffused air distributed from a ridge-and-furrow bottom, had been in operation some eighteen months in November, 1929. A substitute for filtros plates for air distribution had been one of the principal subjects of investigation. Spiral-flow studies are contemplated. It is estimated that the total cost of sewerage improvements now under way will be $80,000,000.

Tokyo—Second in size among cities of Japan is Tokyo, with a population of 2,294,000. Its first water-works was constructed about the year 1590, the water being taken from Inskashira Pond in a western suburb. About 1650 a new works, called the Tamagama-Suido, was built with the Tama River as its source. A wooden conduit more than 24 miles in length was built. The modernization of this system was commenced in 1892 and completed in 1911 at a cost of 9,180,000 yen ($4,500,000) for a works with a capacity of 60 m.g.d. The new works include an aqueduct of greater capacity and of more durable material, slow sand filters, and distribution under sufficient fire pressure everywhere in the city. The city soon outgrew this supply, so that extensions were started in 1913 and have been under way continuously since then, with interruptions during the World War and as a result of the earthquake in 1923.

At present water from the Tama River is led to two storage reservoirs with beautiful surroundings at Murayama. These reservoirs have a total capacity of 3,300 m.g. The water runs by gravity to the filter plant in Tokyo, where it is filtered at the standard rate through slow sand filters and is then pumped through the distribution system. The average water consumption during

1927 was 94,000 m.g.d., or 46.7 gal. per capita. This quantity was supplied to 263,205 hydrants and 350,201 houses, or to a population of 2,096,000.

Although a sewerage system for Tokyo was proposed in 1888, a shortage of funds and other conditions prevented the construction of the first sewers until 1908. The work of the first period was completed in 1924 at a total cost of about 15,000,000 yen ($7,500,000). There are three collection and disposal districts. The Mikawashima district drains northward and inland, discharging into the Sumida River, which flows into the proposed new harbor. The sewerage of this district was completed in 1921, and the treatment plant has been in operation for more than a decade. Complete treatment of the



APPROACH TO WATER PURIFICATION WORKS OF TOKYO
Note the parked areas on both sides of the driveway.

sewage is planned at this plant. The Sunamachi district collecting system drains easterly and is about 50 per cent completed, but practically nothing has been accomplished in the construction of the treatment plant. Treated sewage will discharge into the sea outside of the breakwater for the proposed new harbor. The Haneda or south district system is almost complete. Effluent will be discharged into the sea outside of the proposed new harbor.

The Mikawashima sewage-works includes plain sedimentation tanks with a total area of 308,000 sq.ft., secondary sedimentation tanks and two sludge storage tanks. The nominal capacity of the plant is 20.7 m.g.d. dry-weather flow. Space is available to care for enlargement to 31 m.g.d., from a population of 600,000. Two experimental activated-sludge units are in operation. One unit, with a capacity of 1.2 m.g.d., uses the Sheffield (or Haworth) system of mechanical agitation, and the other, with a capacity of 0.037 m.g.d., employs diffused air. Sludge from the main and test plants is taken to sea in sludge boats and dumped.

The Sunamachi sewage-works, now under construction, is situated at the mouth of the Shin-Arakawa River. It consists of sedimentation tanks with a holding capacity of 11.5 m.g.d. and storage reservoirs to hold the effluent during flood tide. The plant has a capacity of 34.5 m.g.d. dry-weather flow, and is designed for a population of 670,000. The construction of this plant has been commenced.

The Haneda sewage-works is located near the mouth of the Rokugoh River about 6 miles south of the city limits. The works consists of screens and grit chambers followed by sedimentation tanks with a total capacity of 26,300 m.g. The effluent will be chlorinated and discharged into the sea.

Nagoya—The water supply of Nagoya is obtained from a surface source which is filtered through a slow sand filter plant designed and operated similarly to the plant at Tokyo. The plant is in excellent condition, presents a most attractive appearance and the quality of water delivered by the plant exceeds the requirements of the U.S. Public Health Service standards.

The progress of sewage treatment in Japan is marked by the approaching completion at Nagoya of the first full-size activated-sludge plant in Japan. The sewage will be aerated by diffused air in a plant with a nominal capacity of 10 to 15 m.g.d. The plant is located in a densely built-up district. The entire works are, therefore, to be inclosed in attractive buildings to minimize odors and to avoid complaints. The central portion of the city is completely sewered, sewers for the outlying districts are under construction or are contemplated, and about 20 miles of intercepting sewers are now being built. These sewers will lead to three sewage-treatment plants. The effluents from all of the plants will be discharged into small streams which furnish little dilution. Complete treatment is required, therefore, and the requirements have led to the adoption of the activated-sludge process of treatment. (See *Engineering News-Record*, Dec. 12, 1929, for descriptions of the two sewage-works now under construction—EDITOR.)

Kyoto—Located about 340 miles west of Tokyo is Kyoto, with a population of 750,000. It is the most easterly of a group of three great commercial and industrial cities, the two others being Osaka and Kobe. These cities are within a few miles of one another, and including their suburbs, they have a total population of about 4,000,000.

The water supply of Kyoto is taken from Lake Biwa, the largest fresh-water lake in Japan. This is a mountain lake at an elevation much higher than the city. The water is led from the lake to the city by gravity through a double

RAPID SAND FILTER PLANT OSAKA, JAPAN
Entrance in foreground. In background, plant nearly completed.

conduit, with a combined capacity of 850 sec.-ft., but of this amount only 150 sec.-ft. (50 m.g.d.) is used for the public water supply. The remainder is used for hydro-electric power.

There are two water-purification plants in Kyoto. One, an old plant of the Jewell type, is located at Keage and supplies 450,000 people. The other is a slow sand filter plant located at Matsugasaki and supplies 250,000 people. The plant at Keage consists of coagulating basins, twenty tub filters cleaned by mechanical rakes, and a clearwater basin. The average consumption of water in the city is about 20 m.g.d. The maximum day's consumption (July 24, 1919) was 30 m.g.d. About 90 per cent of the population uses the public water supply.

An adequate system of sanitary sewers serves Kyoto.

There is no sewage-treatment plant, as the flow of the Kamo River is sufficient for disposal by dilution alone.

Kobe—This is an important port at the eastern end of the Inland Sea, about 30 miles west of Kyoto. It has a population of about 673,000. Its water supply comes from surface streams by gravity to old slow sand filters and to a rapid sand filter plant completed in 1929. The combined capacity of the two filter plants is 25 m.g.d.

Yokohama—The principal port of Japan is Yokohama, located on Tokyo Bay about 15 miles south of Tokyo. Its population is 645,000. A public water supply was introduced by a company in 1871. Wooden pipes carried water to the city from a tributary of the Tama River. In 1883 the prefectural government, which had acquired ownership of the works some years previously, changed the source of supply to the Sagami River and substituted iron for wood pipes. This reconstruction was completed in 1887. The Sagami River intake is at Aoyama, about 26 miles from the city, 500 ft. above sea level. A storage reservoir and baffled settling basins are located at the intake. The water passes through two parallel aqueducts to the two filter plants, one at Kawai, about 3 miles from the city limits, and the other at Nishiya, just within the city. The filtered water flows to a distributing reservoir on a hill in the heart of the city.

The Kawai filters are of the slow sand type with a capacity of 0.5 m.g.d. The Nishiya plant has a total capacity of 30 m.g.d., of which 20 m.g.d. is provided by old slow sand filters and 10 m.g.d. by recently constructed Jewell rapid sand filters. Repairs to the distribution system and other improvements made since the earthquake have reduced the per capita water consumption from 111 gal. a day in 1924 to 60 in 1925, and 47 in 1928.

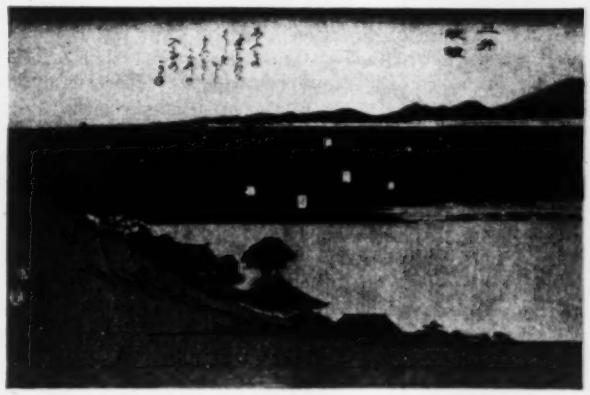
ACTIVATED-SLUDGE TEST UNIT AT TOKYO
Activation by Sheffield or Haworth revolving paddlewheels, which cannot be seen in the view.

Yokohama was the first city in Japan to build a modern sewerage system. It was laid in the Yamashita-cho district about 1890. Since then the system has been extended to include the entire city. The sewage is discharged into Tokyo Bay without treatment.

Keijo—This city, the capital of the Province of Chosen, is better known in America as Seoul, the capital of Korea. It has a population of 350,000 and presents a very attractive aspect. The water-works is a fine example of first-class design and maintenance. Water is taken from the Han River, about 5 miles above the city, and filtered through slow sand filters which were constructed in 1904. The filters have a nominal capacity of 4 m.g.d., but as the average daily water consumption is about 6 m.g.d., the filters are worked a little above nominal capacity and their output is supplemented from the supply of the near-by city of Jinsen. This water is also drawn from the Han River and filtered through slow sand filters. A supplementary supply will soon be available from thirty-four 8-in. wells 50 ft. deep, now being sunk close to the river bank near the present works.

Keijo is almost completely sewered, the sewage being discharged, without treatment, into the Han River.

Dairen—Located in Japanese territory at the southern end of the Chinese Province of Manchuria is the city of Dairen, an important commercial port and the terminus of the South Manchurian Railway. It has a population of about 150,000, mostly Chinese. The water supply is obtained by impounding a small stream with a drainage area of 32 square miles in the hills near Port Arthur. The mean annual rainfall in the district is 16 in. The Ryoto dam, which forms the impounding reservoir, is of masonry, 131 ft. high and 518 ft. long, and impounds 16,000,000 cu.m. (about 4,220 m.g.) of water. The water is pumped from the reservoir to a slow sand filter plant on the heights above the city. The greater portion of the water is distributed by gravity. The capacity of the filters about equals the average consumption of 5 m.g.d., which is about 33 gal. per capita.



LAKE BIWA, SOURCE OF KYOTO'S WATER SUPPLY
From a Japanese woodblock color print in a series entitled "Eight Views of Lake Biwa," the title for this view being "Nightfall at Mii Temple." Mount Fuji is shown in the right background. The lake is about 12 miles wide and 36 miles long. It has long been a favorite subject for Japanese artists.—EDITOR.

In the design of water and sewerage systems the Japanese have followed and are abreast of Western engineering practice. Their designs have been made through the skill of Japanese engineers based upon studies of and inspections of works in Europe and America. The results obtained are object lessons of what can be accomplished in engineering design by study, observation, initiative and boldness.

Crossing Elimination on Federal-Aid Roads

In 1929 a total of 385 railroad grade crossings were eliminated on the federal-aid highway system, according to a report issued by the U. S. Bureau of Public Roads. Crossings eliminated by the construction of grade-separating bridges carrying the highway over or under the railroad numbered 48, while 337 were made unnecessary by relocation of the highway to avoid the railroad. Since 1917, the records of the bureau show, a total of 4,676 grade crossings have been weeded out of the system—995 by grade separations and 3,681 by relocations.

American Society of Civil Engineers Holds Spring Meeting at Sacramento, Calif.

Dams and Water-Supply Subjects Receive Particular Attention—Local Water Conservation Plan of Wide Scope Is Discussed—Registration Exceeds 700

Engineering News-Record Staff Report

LOW rainfall and depleted water resources, which frequently have been recurrent problems in the West, had a decided effect on the discussions at the spring meeting of the American Society of Civil Engineers held in Sacramento, April 23, 24 and 25. Not only was water conservation a major topic but many of the papers presented dealt with works for storing, conveying or surveying water resources. The attendance was unusually large, the total registration being about 720, and since the program was changed at the last minute so that no more than two meetings were under way at any one time, all sessions were well attended.

At the opening session Gov. C. C. Young, in welcoming the convention on behalf of the state, spoke of the debt which California owes to engineers and of its friendly attitude toward them. C. H. S. Bidwell, Mayor of Sacramento, welcomed the delegates to the city. After acknowledgment by President John F. Coleman, C. E. Grunsky (San Francisco) gave reminiscences of early days in Sacramento.

California's Water-Conservation Plan

Edward Hyatt, state engineer, reviewed the fundamental considerations affecting any major water-conservation program. California water prices vary, he said, all the way from 37½c. to $30 per acre-ft. Since 1921 a comprehensive study of water-conservation problems has been under way in the state's 140 drainage basins, the outlay on this investigation to date being almost a million dollars. Significant factors brought out in these studies are that during the last four years 20,000 irrigation pumping plants in the San Joaquin Valley have withdrawn 2,000,000 acre-ft. in excess of the replenishment during the same period, and that 400,000 acres of highly productive land in the central delta region has been seriously threatened by the incursion of salt water resultant from the depletion of fresh-water flow into the delta area.

While a conservation plan has not yet been finally completed, the general scheme has been outlined, and more recently attention has been concentrated on the economic and legal feasibility, methods of financing, and federal consent and participation. The development as now proposed is to store Sacramento River water in the upper reaches of the stream, and release it via the river channel to the delta region, whence it may be pumped in successive lifts up the San Joaquin Channel against the grade to the level required for gravity delivery. This scheme is estimated to cost from $100,000,000 to $700,000,000, according to the number of units that would be included in the original construction.

Discussion by F. C. Scobey, senior irrigation engineer, U. S. Department of Agriculture, pointed out that this is the most extensive survey of its kind ever undertaken by any state. The plans are based on the maximum economic use of the entire water supply, he stated, and look toward co-ordinating present and future development with the ultimate possibilities.

Discussion by J. B. Lippincott, consulting engineer, Los Angeles, stressed the importance to the entire commonwealth of co-operation between state and federal governments as well as co-operation with local agencies in financing extensive and essential water-conservation works, such as storage on the Sacramento, relief of the San Joaquin depletion and provision of adequate supply for southern California from the Colorado River.

In southern California more than half the population and wealth of the state is in an area to which is tributary only 1 per cent of the state's water supply; practically all the surface streams are diverted and wells now are providing 80 per cent of the water supply. The 14,000,000 acre-ft. annually wasted into the sea in Colorado River floods is fourteen times the total southern California water crop.

The major problem, Mr. Lippincott said, is not a question of serving new areas but rather of maintaining existing developments. Adequate engineering data are now assembled on California's major water problems; state and federal aid must be enlisted in solving the legal and financial problems which remain to be worked out.

State Dam Control

State supervision of the design and construction of dams occupied an entire afternoon session. A paper by M. C. Hinderlider, state engineer of Colorado, pointed out the growing tendency toward state supervision in accord with the increasing use of the police power of the states in the interest of public safety. Ever-increasing heights of dams and quantities of storage bring corresponding increases in the extent of lives and property to be considered. From his experience in a state which exercises supervision over approximately 1,000 dams he stated that it often has been found necessary to revise proposed plans and now it is the practice to help select the type of structure best suited to the site and assist in the preparation of plans. In regard to operation and maintenance Mr. Hinderlider suggested that much more discretion is necessary on the part of the authorities than in approval of design.

Discussion by H. W. Dennis, chief civil engineer, Southern California Edison Co., brought out the point that, if the state is to have final authority on the design and methods of dam construction, the same authority ought to take the lead in extensive research work to check and approve advances in the art. Also, since state dam control is based on the police power of the state in the interest of public safety, supervision should be confined to approval or disapproval of the design submitted, and should not enter into type selection or preliminary considerations.

Further discussion brought out the possible danger of centering too much authority in one person when design, geology and construction are three highly specialized fields. Since foundation and spillway difficulties are responsible for most dam failures, they are points to

be watched. The possibility of political interference in administration was mentioned. Various speakers agreed that the administration of any such law is the most important factor in its effectiveness. Careful and just administration can make any reasonable law a public benefit, whereas improper administration can nullify the effects of the best act. It was brought out that great authority is assumed by the state when it takes complete control of the design and construction of all dams, although at the same time most control laws provide that the state does not accept any responsibility or liability.

In the structural division on Thursday afternoon the two central themes were "The Southern Pacific's Suisun Bay Bridge," by W. H. Kirkbride, engineer, maintenance of way and structures, Southern Pacific Co., and "The 328-Ft. Salt Springs Rockfill Dam," by O. W. Peterson, construction engineer, Pacific Gas & Electric Co.

In discussion of the bridge there was particular interest in the effective "sand island" scheme of handling the deep foundations (*Engineering News-Record*, Jan. 30, 1930, p. 174) and the endeavor to make every economical provision against earthquake damage. Discussion by N. F. Helmers, of Siems & Helmers, contractors, reviewed the methods of straightening up the pier cylinders when they settled 7 or 8 ft., and keeping the work up to schedule despite 5-mile tidal currents.

Discussion on Rockfill Dams

On the Salt Springs dam (described in *Engineering News-Record*, Jan. 16, 1930, p. 92), interest attached particularly to the probable amount of settlement. L. F. Harza, consulting engineer, Chicago, compared this structure with the Dix River rockfill dam and reported the latter to have settled in four years 1.7 ft. at a point where the height is 275 ft. The smallness of this settlement he attributed largely to the hosing process during construction whereby fines were washed into interstices. Referring to rockfill dams in general, Mr. Harza said, "There probably is no safer type of dam." C. E. Grunsky, consulting engineer, of San Francisco, contrasted the steep rock faces of the Dix site and its limestone material with the more gradual side slopes and the granite fill material at Salt Springs; these conditions, he thought, indicated prospect of less settlement at Salt Springs than in the Dix dam.

D. C. Henny, consulting engineer, Portland, Ore., pointed out that the friction coefficient of loose rock on itself is not definitely known. Comparing the sliding factors in various rockfill dams, he said that there is usually a large margin of safety against mass sliding but that the local sliding factor may vary greatly. With no flexibility in a concrete facing near the base there is danger of cracking and high-velocity leakage in this zone when the water load comes on and settlement results. Contrary to the plan used in surfacing the Salt Springs dam, Mr. Henny thought that convexity in a vertical direction might have been preferable to the concave curve used on the face. Care must be taken, he said, to avoid indiscriminate dumping of large rock masses of different sizes in such dams; the use of a hydraulic jet to fill in the voids is desirable, to decrease settlement.

A. H. Markwart, vice-president, Pacific Gas & Electric Co., suggested that "horizontal compaction" and cracking at the toe would not occur in the Salt Springs dam, because of the 15-ft. thickness of derrick-placed rock on the upstream face, finished along the toe with mortar-filled rock backing beneath the thicker concrete facing at the toe. Answering a question as to the safe limit in height for a dam of this type, Mr. Markwart said the height might be almost anything provided the dam is properly built of good materials and can be well filled in or allowed to settle well before the face is put on.

Highway Construction Problems

The highway division meeting was featured by a discussion of prequalification of contractors. C. H. Purcell, California state highway engineer, took the standpoint of the engineer; Dr. L. I. Hewes, deputy chief engineer, U. S. Bureau of Public Roads, reviewed legal aspects; and Walter Wilkinson, president California branch, Associated General Contractors of America, took the standpoint of the contractor. Dr. Hewes said that no constitutional prohibitions prevent the adoption in any state of this system, which is now recognized by six states and the U. S. Bureau of Public Roads. Mr. Wilkinson solicited aid from all branches of the industry in helping the contractors "put their house in order" by excluding through this plan the irresponsible bidder.

On the subject of developments in the construction of low-cost bituminous-treated rock and gravel roads, Walter N. Frickstad, for fifteen years with the U. S. Bureau of Public Roads and now city engineer of Oakland, Calif., stated that the eleven Western states now have 6,100 miles of low-cost surfacing of this character, of which 2,500 miles was completed during the last season. E. Q. Sullivan, district engineer, California Highway Commission, San Bernardino, Calif., said that the annual maintenance cost of this type of surfacing in his district is $300 per mile. A. H. Hinkle, chief engineer of maintenance, Indiana State Highway Commission, described the multiple-lift bituminous surfaces successfully maintained in his state, which have a construction cost of less than $6,000 per mile.

Western highway construction problems were presented in detail by a series of slides shown by C. S. Pope, chief construction engineer, California Division of Highways. The disposal of redwood stumps 20 ft. in diameter was shown to be a real construction problem. J. S. Bright, construction engineer, U. S. Bureau of Public Roads, stressed the importance of preserving forest cover in the national parks and forests. Joseph M. Howe, consulting engineer, Houston, Tex., reviewed in some detail the $300,000,000 highway bond issue which Texas now has under consideration.

Colorado Aqueduct

A paper on "The Proposed Colorado River Aqueduct and Metropolitan Water District," by F. E. Weymouth, chief engineer, Metropolitan Water District, Los Angeles, described the extensive work already done and reviewed four main aqueduct locations from the river to the vicinity of Los Angeles. The projects range from an all-tunnel scheme to a pumping scheme with a diversion point near Yuma. Consideration of such factors as deep gravel-filled valleys unsuited to tunnels, the silt problem at lower diversion points, pumping lifts balanced against pumping costs, and the need for adequate terminal storage make the determination of the final location extremely difficult. Any route must cross the important San Andreas fault. The conduit will be designed for 1,605 sec.-ft. to take care of a 1,500 sec.-ft. diversion with allowance for interruptions, for maintenance and inspection amounting to about 7 per cent of the time. It is hoped that the final location may be chosen in a few months, and that a bond election will be possible before the end of the year.

Dam foundation problems of unusual interest were described in a paper on the work under way at the Rodriguez dam near Tijuana, Mexico. The site of this Ambursen structure, 187 ft. high above streambed, contains a faulted zone 20 ft. wide and a much wider area of unsuitable foundation rock. This condition requires supporting the four central buttresses on an arch spanning the streambed and building the deep cutoff wall by an unusual method.

Some economic phases of irrigation work were considered in a paper by C. C. Cragin, general superintendent and chief engineer, Salt River Valley Water Users Association, Phoenix, Ariz., which discussed the development of hydro-electric power as an aid to irrigation. Wherever practicable the development of power as a byproduct in connection with irrigation projects is a valuable help in carrying the financial load of the water development. In exceptional cases, such power can be distributed by the district profitably, but more often it is advantageous to wholesale the output to existing agencies. In many instances this byproduct produces return on the power-production investment sufficient to relieve carrying charges on the entire cost of the water supply.

Surveying and Mapping

Describing the "Preliminary Topographic Surveys for the Proposed Colorado River Aqueduct," E. A. Bayley, engineer of surveys, Los Angeles Department of Water and Power, outlined the methods used in mapping the rugged mountainous and desert country in the area bounded by the Boulder dam site, Yuma and the terminal near Los Angeles. Compared with the original Owens Valley aqueduct survey the operation shows many improvements, particularly in transportation. One interesting point was the statement that whereas in 1923, when the work was started, the use of airplane mapping was investigated and believed to be unsatisfactory, progress in this field has been so great that, were the work to be started now, this method would be given serious consideration.

Letters to the Editor

Battering of Rail Joints

Sir—In the account of the A.R.E.A. convention in *Engineering News-Record* of March 20, my reply to a question about batter in rail joints is reversed from the statement made by me. I said the bad result would come from a downward break in the curves of flexure at the two rail ends, and not when it is arched upward, as noted in your account. The matter is of little consequence, but I am writing to make sure that in case any reference may be made to the matter again the statement will be properly quoted.

A. N. TALBOT,
Urbana, Ill., University of Illinois.
March 24, 1930.

Another Engineer in Literature

Sir—After reading your editorial in the April 10 issue on "Literary Engineers," the thought came to me that there are probably many more engineers in America who deserve to have their names listed with those of Colonel Green and Professor Jacoby as literary men. One that occurs to me is Carl A. Norman, professor of machine design at Ohio State University, who published last year "A Galilean," a dramatic poem in six acts, which has received much favorable comment. Professor Norman's accomplishment is especially remarkable in that English is not his native language. He was born in Finland of Swedish parents.

RALPH W. POWELL,
Columbus, Ohio, Department of Mechanics,
April 12, 1930. Ohio State University.

Contractors' Liabilities in Excavation Work

Sir—In the April 10 issue of *Engineering News-Record* Nathan Young interpreted and explained statutes governing liabilities of owners and contractors where excavations affect the property of others, and in so doing the author is to be commended for the simplicity and clarity of presentation of a timely subject.

In connection with contracts for public works, a contractor's liability clause is usually inserted wherein the contractor is bound to make good, at his own expense, damage done to abutting property and indemnifying the public authority against all claims for such damage.

A decision illustrating the above is found in the case of Schnaier v. Bradley Con. Co., 181 App. Div. 538. (Abutting building damaged by subway contractor who has agreed to "make good" any damage to abutting property and not merely to indemnify the city—No allegation that contractor was negligent—Such privity exists between city and abutting owner as to entitle the latter to sue the contractor under the contract.)

Brooklyn, N. Y., JACOB JOSEPH.
April 17, 1930.

Early History of the Dragline Excavator

Sir—Referring to the article on the development of the dragline excavator by J. C. French in *Engineering News-Record*, April 3, 1930, p. 556, the writer can supplement the early history of this machine to some extent, and in the interest of justice to certain men who were largely responsible for the invention of a splendid dirt mover, perhaps the following may be worthy of publication.

In the opinion of the writer, Charles Kerns, who at one time was superintendent for Benezette Williams & Co., contractors on the Illinois & Mississippi Canal, and a young engineer named Page, whose initials I do not remember, deserve the credit for originating this machine.

As superintendent for Benezette Williams & Co., Charles Kerns about 1901 built an orange-peel bucket machine for use in the excavation of parts of the feeder canal of the Illinois & Mississippi Canal (the so-called Henepin Canal) that embodied some innovations in excavating machinery which were very successful and which resulted in the acquisition by other contractors and by the U. S. Engineers of like machines for use on other parts of the canal.

This orange-peel machine consisted of a wooden platform mounted upon skids which moved on wooden rollers and supported a turntable derrick. This derrick was capable of being revolved through the complete circle by means of a steel rope which encircled the circular 80-lb. railroad rail constituting the turntable track and was led by sheaves on the front of the derrick to a swinging engine.

The early machines had wooden booms about 64 ft. long and were equipped with 1¼-cu.yd. orange-peel buckets. The operating machinery consisted of a standard two-drum 35-hp. hoisting engine with vertical boiler and a separate reversible swinging engine.

Charles Kerns claimed to have developed the turntable and swinging mechanism for previous use on a piledriver which he built and used in driving piles for the Chicago federal building, and the writer is under the impression that he obtained patents on these. But whether he did or did not secure patents, he was the sole builder of machines of this type for two or three years. In 1903 the writer induced the district engineer to have Mr. Kerns build a machine of this description for his use in excavating Mile 23 of the I. & M. Canal

by force account, as a part of a large forfeited contract which was completed by government forces under the writer's direction.

Also about this time two young engineers, Page and Schnable, who were just out of school, bid upon and secured the contract for eight locks located on the western section of the Illinois & Mississippi Canal. Much of the excavation for the first lock which they undertook consisted of rock, and while the Kerns orange-peel machine which they used for earth excavation did excellent work in earth, when it came to moving rock it was, of course, found unsuitable. Having tried the orange-peel bucket on rock, Page sat down and drew a sketch of the first successful dragline bucket. He then jumped on a train and ran up to Chicago and had it made. This worked fairly well in rock, and proved an excellent dirt-moving bucket.

No improvement in the general design of this first Page bucket has been made to this day, and about the only betterment in the bucket has been in the use of heavier material and the addition of hard steel teeth for use in hard material.

Mr. French refers to earlier attempts at dragline work on the Chicago Drainage Canal which were not successful. The writer knows nothing of that, but the above is, in brief, the beginning of the successful dragline machine. This machine is capable of still further development and when perfected will be a wonderful, versatile dirt mover.

If either Mr. Page or Mr. Kerns happens to see this letter it is hoped that additional information as to the origin of the dragline may be furnished. JOSEPH WRIGHT.

Chattanooga, Tenn.,
April 10, 1930.

E. R. Schnable was division engineer of the Summit division of the Chicago Drainage Canal. This division embraced the first 7½ miles of the canal out of Chicago. J. W. Page was engineer for Gahan & Byrne, who were the contractors for sections G and H (about 2 miles) of the Summit division. All of this division was trapezoidal section in earth, and on it the contractors developed some of the most unusual earth-moving devices of that time and some that have a large place in present-day earth-handling operations. Among these, J. W. Page contributed a perfected design of tipple incline which had been first employed on an adjacent section of the canal by E. Lee Heidenrich, who adopted and adapted it from coal-mining practice.—EDITOR.

Pioneer Engineers in Massachusetts

Sir—The first item under "Brief News" on p. 500 of your March 20 issue is somewhat askew, and you may be interested in correcting it, particularly as it affects the name of one distinguished engineer and the place in chronology of another. In the first place, in line three of that note you have Simon, it should read Simeon; and in the second place, Mr. Walling, I feel sure, was not making surveys in 1830. My reason for that belief is that I was a member of one of his surveying parties in 1886 and I do not think he was then much over 60 years old. Although not in robust health, he was actively engaged in heading a field party.

LEWIS JEROME JOHNSON,
Professor of Civil Engineering,
Harvard Engineering School.

Cambridge, Mass.,
April 2, 1930.

Benchmarks on Trees

Sir—I have read with much interest your article entitled "Benchmarks Established on Trees," and believe that the statements made therein should be somewhat modified.

A few years ago I had charge of some work which necessitated the running of a line of levels a little more than 100 miles long. This work was carried out in the North, and since exposure of rock occurred in only three convenient places, trees were used for the purpose of establishing benchmarks. A year after the original survey was made check levels were run and it was found that some benchmarks had moved. If I recall correctly, the maximum seasonal variation was that of a benchmark established on a spruce tree which was growing in a tundra overlying frozen muck. This benchmark showed a variation of nearly 0.2. A study was therefore made and it was found that, where trees were growing in the moss or tundra overlying a bed of frozen muck, heaving was likely to take place in the winter, thus making it impracticable under these conditions to use trees for benchmarks. G. W. RATHJENS,

Salt Lake City, Utah, Acting Chief Engineer.
April 1, 1930. U. S. Smelting, Refining & Mining Co.

Causes of Concrete Disintegration

Sir—The article by Thaddeus Merriman on "Durability of Portland Cement" in *Engineering News-Record* for Jan. 9 brings out some very interesting aspects of the problem of producing durable concrete. While there is much in this article of constructive value, the general impression which it gives is likely to be misleading.

One can thoroughly indorse such statements as "Durable concrete for outdoor exposure can be made only from cement having such inherent characteristics that it will develop hydration products which will remain permanent and continue to resist the disintegrating influences of the environment under which the concrete is placed. The determination of these characteristics is one of the important needs of the engineer whose concrete is exposed to sunshine, rain, heat and cold in all their many combinations and effects. His concrete must also, in many situations, resist the solvent effects of percolating water as well as the destructive action of salts which that water carries in solution." Where this article is likely to be misleading is in that part dealing with the causes of disintegration and the assumption that artificial exposure to sodium sulphate provides a measure of the effects of exposure to fresh water or ordinary processes of weathering.

Mr. Merriman makes the statement, "Every engineer has seen portions of a concrete structure disintegrate at an early age while other parts of the same structure showed every evidence of continuing permanence and durability. Differences such as these can be satisfactorily accounted for only by predicating that cement differs both from brand to brand as well as from time to time within a particular brand."

Figs. 1, 2 and 3, reproduced from the fifth article of a series by the writer on "Basic Principles of Concrete Making," which appeared in *Engineering News-Record* during April and May, 1929, are typical cases of the kind referred to by Mr. Merriman. Portions of these structures shown are badly disintegrated, while other portions "show every evidence of continued permanence and durability."

The failure of certain portions of these structures to

FIG. 1—BUTTRESS OF A DAM AFTER TWENTY YEARS' EXPOSURE

Showing disintegration due to the accumulation of water and laitance. Note the disintegration at the top of a layer and the sound concrete at the bottom.

FIG. 2—SECTION OF A RETAINING WALL 22 YEARS OLD
Showing disintegration at the bottom of a section. Note the good condition of the concrete outside the affected areas.

resist weathering is clearly the result of improper methods of placing. This seems so evident from the pictures themselves that it is hard to understand how serious consideration can be given to the suggestion that in these particular cases disintegration is the result of differences in cement. Recognizing that the clinker from a given cement kiln can be affected by changes in operating conditions, the fact remains that such changes do not occur suddenly, but rather in the form of a gradual transition from one set of conditions to another. When we couple with this fact the operations of clinker storage, grinding, bin storage and sacking, all of which serve to mix and blend the product thoroughly, it is inconceivable that changes could occur with such abruptness as to account for the disintegration shown in these illustrations, solely on the basis of cement quality. Further, the very operations of mixing, handling and placing the concrete produce such additional blending that, even were variations in the cement capable of producing such differences, any disintegration, should it occur, would be more general over the exposed areas.

Those familiar with the placing of concrete will realize how the defects illustrated in these figures are the results of the method of placing. The buttress wall of Fig. 1 is typical of wingwalls everywhere where concrete is deposited in a single place and allowed to flow over long distances. Disintegration always begins at the farthest point where excess water and fine material accumulate.

The retaining wall in Fig. 2 illustrates the disintegration at the bottom of a section. Such cases frequently happen in placing dry mixes where the first batch fails to puddle properly into the corners. Similar cases are sometimes due to placing concrete over a bed of shavings or other debris accumulated subsequent to the cleaning or inspection of the forms. The case illustrated in Fig. 3 is the result of a gross excess of water and extreme carelessness in placing. Though such practice is inexcusable, there are numerous examples which indicate that the practice is altogether too prevalent.

FIG. 3—AN ERODED LAITANCE SEAM IN DAM LESS THAN SEVEN YEARS OLD

The sugar solubility test, which Mr. Merriman proposes, seems to be quite useful in determining the resistance of different cements to the action of sodium sulphate. However, as brought out by W. F. Way in in his letter to the editor in the issue of March 6, there is as yet no proof that the behavior in the sodium sulphate solution is any indication of the performance which may be expected of the cement under normal concrete use. In fact, there is every reason to believe from the experience of the past that practically all of the cements, if properly used, are capable of producing durable structures.

The above illustrations of concrete structures are typical of any number that can be produced showing that, where disintegration occurs, it is almost universally confined to parts of the structure where defective concrete has resulted from improper methods of manipulation. This observation has been so thoroughly sustained in a survey of more than 600 structures throughout the United States that it can be said that, in general, the cements used have "such inherent characteristics as to develop hydration products which will remain permanent." The effects observed are not due to chemical disintegration of the cement, but are the result of physical disintegration of these areas of weak, porous concrete, through either frost action or solution by percolating water. In general, the areas affected are less than 10 per cent of the total area exposed, and even where the proportion is higher the unaffected parts are still in good condition and capable of indefinite resistance to the particular type of exposure. Certainly it will not be claimed that the use of cement of any other chemical characteristics would have eliminated these construction defects, nor is there any reason to believe that with such construction defects would the structures perform any better, regardless of the characteristics of the cement.

F. R. McMillan,
Director of Research,
Portland Cement Association.

Chicago, Ill.,
April 8, 1930.

Tests of Concrete

Sir—In the issue of March 6, 1930, I note the reply of Mr. Griesenauer to the analysis of his suggested concrete "test" method made by the undersigned, published by you Feb. 13, 1930.

The errors which he feels are avoidable are, on the contrary, I believe, integral, inescapable parts of his method, and the number of steps which he gives as ten can be counted and found to be about thirty. Most important, the "test" which laboriously and inaccurately determines the proportions of a limited sample of concrete and jumps by theoretical assumptions to a guess at the future strength is unnecessary and adds nothing to the available knowledge of the theoretical future strength of concrete when mixed by measuring the materials and water through hoppers and tanks.

Zara Witkin,
Chief Engineer,
Herbert M. Baruch Corp.

Los Angeles, Calif.,
April 12, 1930.

Well Drillers Consider Pollution of Underground Waters

Sir—I have read with much interest the editorial in your issue of March 13, 1930, p. 430, regarding the pollution of the underground water supply of Fond du Lac, Wis., through an abandoned well. This is a subject which will doubtless have to receive more systematic attention and regulation in the future than it has in the past.

You may be interested to know that in the recent meeting of the American Association of Water Well Drillers, at Minneapolis, the subject of pollution of underground water by accidental or intentional drainage of polluted water into the water-bearing formations was given considerable attention and was made the subject of a resolution. The subject was discussed chiefly by the drillers themselves, some of whom have become aware of the injury that will result to their business from the pollution of underground-water supplies.

O. E. Meinzer,
Geologist in Charge,
Division of Groundwater.

Washington, D. C.,
March 30, 1930.

News of the Week

Engineers Again May File Building Plans in New York City

Building Departments Now Accept Plans for All Types of Buildings Except Multiple Dwellings

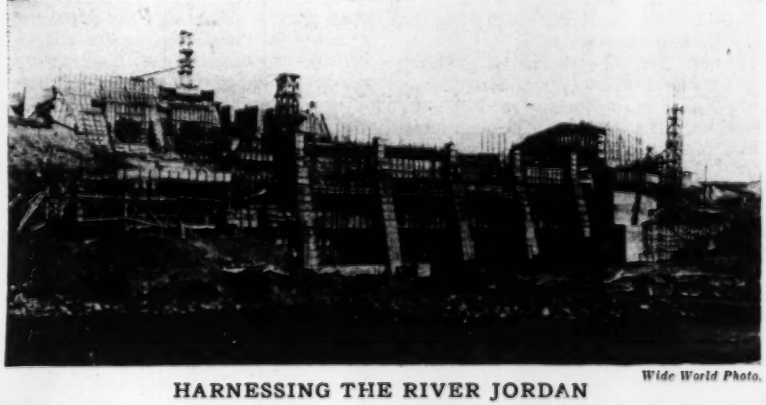
BUILDING departments in the city of New York, which since late in January have refused to accept building plans from engineers, are again accepting plans from them. Since the latter part of January certain boroughs have accepted building plans only when filed by registered architects. The only restriction now placed upon the filing of plans by engineers is that of the multiple dwellings law, which requires that plans for such structures be filed only by the owner or an architect acting as his agent. The constitutionality of that requirement is being tested in the courts.

Restrictions upon the filing of plans by engineers came about through an interpretation put upon the practice act of the architects' registration law shortly after the practice act went into effect on Jan. 1. Upon the strength of a letter written to the superintendent of buildings in the Borough of Bronx by a deputy attorney-general in the department of education, the superintendents of four of the five boroughs of New York City late in January decided that they could not accept building plans from engineers under the amended architects' law. The superintendent of building in Brooklyn alone did not consider the deputy attorney-general's letter binding upon him nor that the law prevented the filing of plans by engineers. Some weeks later the superintendent in Manhattan came to the same conclusion and now the three other boroughs have come into line.

This change of position on the part of the building superintendents restores engineers to their former status in the matter of the preparation and filing of plans for buildings except multiple dwellings in New York City, and so makes unnecessary some of the bills to amend the engineers' and architects' law which failed of passage in the recent legislative session on account of the opposition of the architectural profession. For further details see *Engineering News-Record* of Jan. 30, 1930, p. 207; Feb. 13, p. 270; Feb. 20, p. 309; and April 10, p. 599.

Termites Damage City Hall at New Orleans

Destruction of vital timber supporting members in the city hall at New Orleans, La., by termites has proceeded so far that the expenditure necessary to replace unsafe portions and to termite-proof the new work would be unwise, according to a report submitted to the commission council by the Termiteoil Corp., which has made a thorough examination of the building. The report has been referred to Bryson Dallas, city engineer, for study. It states that many of the beams, rafters and plates beneath the roof of the building have been almost completely eaten away and there is reason to believe that much additional timber embedded within the masonry walls is badly affected. In order to control the termites, the report states, extensive replacements to the timbers and trim of the building are necessary, together with a new roof of different drainage design and a new floor at the ground level. Some foundation work would also be necessary.



Wide World Photo.

HARNESSING THE RIVER JORDAN

Construction view of the hydro-electric power plant now being built on the River Jordan in Palestine. A description of this plant and of the complete project appeared in *Engineering News-Record*, Aug. 30, 1928, p. 321.

Contracts Signed for Allocation of Power From Boulder Dam

Congressional Appropriation to Be Sought at Once — Injunction May Be Asked by Arizona

CONTRACTS underwriting the entire power capacity of Boulder dam were signed by California groups April 26. The next step will be to ask Congress for an appropriation to start the job. It is understood that matters have been arranged with the Budget Bureau so that Secretary Wilbur's request will go through without delay. The contracts, which are based on the allocation announced by the Interior Department late in March, were necessary, according to the Boulder Canyon act, before the appropriation could be made.

Under the allocations which have been made the Southern California Edison Co. is expected to get more than half of the total power until the other interests are in a position to utilize a larger proportion of their share. The Metropolitan District receives 36 per cent of the total; Arizona 18 per cent; Nevada 18 per cent; the city of Los Angeles 13 per cent; small communities 6 per cent; and the Southern California Edison Co. 9 per cent. The Edison company and the city of Los Angeles will divide equally the proportions that the others are not in a position to use. It is expected that practically the entire amount allocated to Arizona and Nevada will be available in the early years of the project. The Metropolitan District will hardly be in a position to use more than one-third of its allocation. The amount that the Metropolitan District can use depends upon how much of its municipal supply aqueduct project can be deferred until its full capacity is needed. With the heavy outlay that will be required for transmission lines and other expenses, it is probable that provision will not be made for the transportation of more than 500 sec.-ft. in the aqueduct. The small communities will be able to absorb their entire 6 per cent, it is expected, if arrangements can be made with Los Angeles to transport the power.

While Senator Johnson and Representative Swing have condemned the allocations made by Secretary Wilbur as being a perversion of the spirit of the act, they are not expected to oppose the appropriation now that Los Angeles and the smaller communities have signed the contract. There is some likelihood of a filibuster against the appropriation item by the Arizona Senators. Since this item will be before Congress at

about the time of adjournment, it gives a particular advantage to any determined group anxious to talk the measure to death. The general expectation in Washington is that Arizona will not retreat now. It is fully expected that injunction proceedings will be brought as soon as construction work actually starts.

The Bureau of Reclamation plans to begin work on the camp just as soon as the appropriation becomes available. If there is no interference with construction it is expected that the railroad can be completed to the dam site so that work on the four 50-ft. diversion tunnels can begin in July, 1931. Engineering plans are almost in their final form, the consultants on the project being in accord as to design matters. The dam design has been approved in tentative form, being subject to revisions due to the additional 25 ft. in height. Model tests are to be run at Boulder, Colo., as is the practice of the Bureau of Reclamation on major structures.

Power Possibilities Excluded From Delaware Water Case

Evidence as to the feasibility of future dam construction on the Delaware River for power purposes will be excluded from consideration in the pending suit of the State of New Jersey against the State and city of New York in regard to water diversion, according to a statement made April 28 by the Special Master. Quoting decisions in New York v. Illinois and Sanitary District of Chicago, 274 U. S. 488, and New Jersey v. Sargent, 269 U. S. 328, the Master stated that he is not at liberty to consider abstract questions respecting the right of New Jersey and her citizens to use the waters for such purposes. New Jersey, however, was allowed to proceed with her evidence after the warning that it would be excluded by the Master.

Arizona Completes One Bridge and Starts Work on Another

Arizona's newest state highway bridge, which crosses the Agua Fria River at Coldwater on the Phoenix-Yuma highway, was opened to traffic on April 3. The new bridge, which cost approximately $200,000, is 1,277 ft. in length, with five main steel spans of the camelback truss type, each 153 ft. long. The roadway is 20 ft. between curbs. Eight concrete spans, each 32 ft. long, form approaches at each end of the bridge proper. The structure was built by the F. E. Stearman Construction Co. A. W. Newhall was the resident engineer in charge of the work for the highway department. Ralph Hoffman was the designer.

Excavation work has begun for a new ten-span concrete arch highway bridge which is to be built across the Salt River at Tempe, Ariz., by the Lynch-Cannon Construction Co., of Los Angeles, Calif. The contract price was $397,608.10, with 10 per cent allowed for engineering costs and contingencies. This structure is to be 1,507 ft. in length, with a 36-ft. roadway and two 5-ft. walks.

AN ENGINEER IS HONORED

A statue of the late Samuel Rea, president of the Pennsylvania Railroad from 1913 to 1925, which was unveiled April 9. It is located in the Pennsylvania Station at New York City, and faces a statue of Alexander J. Cassatt, one of Mr. Rea's predecessors.

Sherrill Resigns as City Manager of Cincinnati

Following four years and four months of service, Col. C. O. Sherrill, first city manager of Cincinnati, Ohio, has announced his resignation to become vice-president of the Kroger Grocery & Baking Co. as public relations counsel and director of personnel policies. According to his own announcement, he intends to remain in office until his successor is appointed.

Colonel Sherrill, born in Newton, N. C., in 1876, was graduated from West Point with honors in 1901, and served with the Corps of Engineers until his appointment as city manager of Cincinnati Jan. 1, 1926. During the war he was in command of the 302d Engineers, served as chief of staff of the 77th Division, and later went to Germany as assistant chief of staff of the Third Army. He was awarded the Croix de Guerre, with palm, for services rendered the French army during the fighting on the Vesle. Upon his return to the United States he was placed in charge of fortification work throughout the United States, also acting as a member of the Board of Surveys and Maps and of the interdepartmental board of Alaskan affairs. Colonel Sherrill was aide to President Roosevelt in 1903 and 1904 and chief military aide to President Harding from 1921 to 1925, when he was relieved of his duties to devote all his time to the direction of public buildings and public parks at Washington, D. C. He also acted as executive officer of the Arlington Memorial Bridge Commission.

Three Locks Opened on New Welland Canal

The northern section of the new Welland Ship Canal was unofficially opened to traffic on April 21 when the steamer "Georgian," of the Northwest Transportation Co., entered Lock No. 1 from Port Weller, the Lake Ontario end of the canal. The event signalized the opening of three of the great lift locks of the new canal. With the section opened last year and the locks now placed in operation, almost the whole length of the 25-mile canal is opened to traffic. The short section near the town of Thorold which still remains under construction contains three pairs of locks, giving a vertical lift of 139½ ft., which are expected to be completed in time for the formal opening of the canal in July.

Contracts Awarded for Fort Worth Railway Improvements

General contracts for railway improvements in Fort Worth, Tex., recently awarded by the Texas & Pacific Railroad include a thirteen-story passenger station and office building and an eight-story freight depot, the joint project to cost approximately $4,000,000. Construction is expected to start in the near future. In addition, the railroad has adopted plans for an underpass at Henderson St. to cost $501,000, bids for which will be received early in May.

New Toll Highway Across Austrian Alps Proposed

Construction of a new automobile road across the Austrian Alps in the vicinity of the Grossglockner is being considered, according to *Commerce Reports*, published by the U. S. Department of Commerce. The proposed highway would provide a much shorter route between southern Germany and Italy and the Adriatic. The Province of Salzburg has passed a resolution undertaking to bear its share of the cost of the undertaking, provided the provinces of Tyrol and Carinthia agree to participate. The proposed route would be 27 miles long, with a summit 8,250 ft. above sea level, at which point there would be a tunnel 840 ft. long. The cost of the entire project is estimated at between $1,140,000 and $1,710,000, and it is proposed to charge a toll of about $3.50 per car to meet interest and amortization charges.

New Oregon Railway Approved

The Oregon Electric Railway has been authorized by the Interstate Commerce Commission to construct a 27-mile line in Linn County, Ore., extending from a connection with the Southern Pacific at Lebanon to Cascadia, with three branches aggregating 28 miles in length. The new line will provide a rail outlet for timber in the basin of the South Santiam River on the west slope of the Cascade Mountains. The original plan contemplated the construction of a line between Albany and Lebanon, but an agreement subsequently made with the Southern Pacific provides for trackage rights over its line between these points. As revised, the construction cost of the project is estimated at $2,595,188. Approximately 20,000 ft. of trestles and 2,000 ft. of tunnels will be built. The limiting grades opposed to outgoing traffic, which will predominate, will be 1 per cent on the main line and 2 per cent on the branches. On the main line the sharpest curves will be 12 deg.; on the branches 14 deg.

Form Worldwide Organization for Structural Engineers

Membership applications are now being received by the International Association for Bridge and Structural Engineering, with headquarters in Zurich, Switzerland, formed as a permanent organization to carry on the work started at international conferences held in 1926 and 1928 at Zurich and Vienna. The purpose of the new association is to facilitate the exchange of theoretical and practical knowledge, the results of research work, and other information on the design and construction of long-span bridges and large buildings. This will be done by means of printed reports distributed to members and by the organization of international conferences at suitable intervals. The next congress is scheduled for Paris, to be held some time in 1932.

Control of the new organization is vested in a committee consisting of one or two delegates from each country, according to the number of memberships represented. This committee appoints a president, three vice-presidents, a general secretary and two scientific secretaries. The present incumbents are: president, Prof. Dr. Rohn, president of the Swiss Federal Institute of Technology; vice-presidents, Dr. ing. h.c. Moritz Klonne, Germany, E. Pigeaud, of the Ecole Nationale des Ponts et Chaussées, Paris, and Mitchell Moncrieff, president of the Institute of Structural Engineers, London; general secretary, Prof. Dr. ing. L. Karner, of the Swiss Federal Institute of Technology; scientific secretaries, Dr. ing. Bleich, Austria, whose substitute is Prof. Fernand Campus, Belgium, and Prof. Godard, France, whose substitute is Dr. ing. Petry, Germany.

Membership in the new association is open to any individual interested in bridge and structural engineering, provided he belongs to one of the recognized scientific or technical societies of his country, and also to government or local authorities, associations and commercial firms. Annual dues are $2 for individual memberships and $10 for collective memberships. Applications should be sent to Prof. Dr. L. Karner, general secretary, International Association for Bridge and Structural Engineering, Swiss Federal Institute of Technology, Zurich, Switzerland.

Vicksburg Bridge Opens May 20

Formal opening of the Vicksburg bridge across the Mississippi River, the only crossing over the river in the 850-mile stretch between Memphis and the Gulf, is scheduled to take place May 20. The main river crossing consists of a cantilever truss structure with a center span of 825 ft. and anchor arms of 420 ft. and three single truss spans of 420 ft. each. Erected as a private toll bridge, it will carry an 18-ft. highway and single-track railroad.

New York Legislation Includes St. Lawrence Bridge Plan

Recent legislation by the State of New York provides for the creation of a commission to survey the feasibility of an international bridge or bridges across the St. Lawrence River near Ogdensburg, N. Y., and an appropriation of $15,000,000 for the elimination of grade crossings in the city of Buffalo. A bill creating a state department of architecture, passed by both houses of the legislature, was vetoed by Governor Roosevelt on the ground that it did not fit in with the accepted plan of state government.

The bridge commission will study possible bridge sites, prepare cost estimates, make drawings, surveys and other field investigations and prepare financing plans for the number of crossings over the St. Lawrence deemed justifiable. It will also confer with authorities of the Province of Ontario, the Dominion of Canada and the federal government.

At the present time the Canadian House of Commons has under consideration a proposal to build an interprovincial bridge across the St. Lawrence at a point just east of Cornwall, Ont. Although this private toll structure would be entirely in Canada, it would be, in effect, an international bridge, as the south end would be only half a mile from the international boundary and would be approached by a New York state highway. The structure would have a total length, with connecting roadways, of 2 miles, and would consist of a series of connected spans touching on three small islands in the St. Lawrence River.

Calderwood Dam Gates Closed

Stream diversion outlet gates on the Calderwood dam were closed April 15, allowing the reservoir to commence filling. The structure, a thin-section concrete arch 230 ft. high, was built by the Knoxville Power Co., a subsidiary of the Aluminum Company of America, on the Little Tennessee River 45 miles south of Knoxville, Tenn. A gravity-section concrete dam 40 ft. high built just below the arch to create a cushion pool to receive the overflow from the high dam is a feature of the project, which was described in *Engineering News-Record*, Dec. 19, 1929, p. 954. The power house installation consists of three 56,000-hp. reaction turbines operating under a head of 213 ft. The Calderwood project is the third to be completed in the Aluminum Company's development of the Little Tennessee River and its tributaries, the others being the Cheoah dam, completed in 1919, and the Santeetlah dam, completed in 1928.

Favorable Dam Site Reported in San Gabriel Canyon

Rock and general foundation conditions far superior to those at the abandoned Forks site have been uncovered by excavations and exploration of a new site for the $25,000,000 dam in San Gabriel canyon in southern California, according to a report made by E. C. Eaton, Los Angeles County flood-control engineer. The new site, located above the Forks site, is said to be capable of supporting a structure almost as large as the 493-ft. dam project originally projected. Eleven other sites, tentatively under consideration, still remain to be reported on before a final recommendation is made to the board of supervisors. Reports on the twelve prospective sites are scheduled to be completed by July 1.

Port Authority Changes and Gas Tax Rise Approved by N. J.

Legislation in New Jersey recently approved by Governor Larson provides for the issuance of bonds totaling $100,000,000 to finance public improvements, increases the gasoline fuel tax from 2c. to 3c. to pay amortization charges on the bonds, and consolidates the Port of New York Authority and the Holland Tunnel Commission into a larger Port Authority charged with the construction of interstate bridges and tunnels in the New York City metropolitan district. The first two of these measures must be approved by a referendum vote at the general election in November before becoming effective.

Funds derived from the bond issue would be expended as follows: $83,000,000 to finance state highway building and grade-crossing elimination; $10,000,000 for a building program of the Department of Institutions and Agencies; and $7,000,000 for the acqui-

sition of sources of water supply. The increase in the gasoline tax, besides providing funds for amortization of the bond issue, will return approximately $5,000,000 annually to municipalities in the state.

The reorganization of the Port Authority is in accordance with similar legislation adopted by the State of New York, outlined in *Engineering News-Record*, April 17, p. 665. The enlarged body thus created is given permission to proceed with plans and investigations in connection with the proposed midtown vehicular tunnel under the Hudson River in the vicinity of 38th St., Manhattan. It also takes over operation of the Holland vehicular tunnel, the Fort Lee bridge, now under construction, and other traffic facilities in the region.

Seattle Plans Steam Power Plant

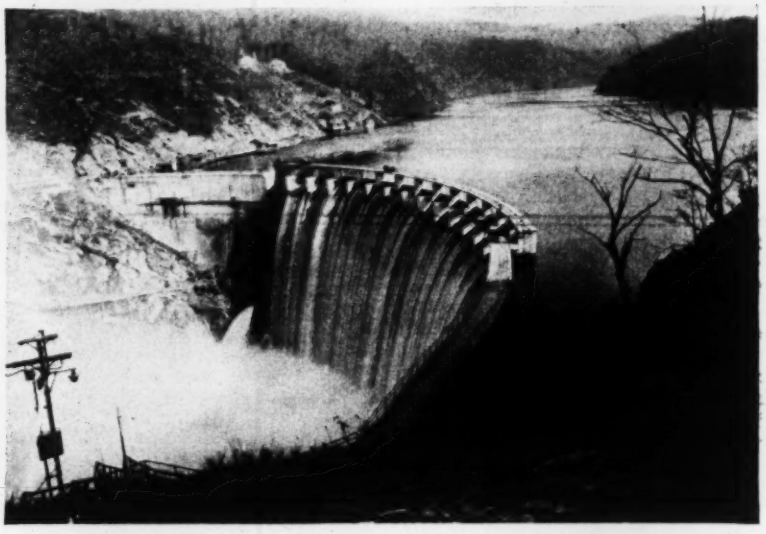
Determined to meet the challenge of future droughts, such as the one which caused a shortage in power output from hydro-electric plants last fall, city officials of Seattle, Wash., are considering plans whereby the municipal light and power system will be enlarged by the construction of a steam plant in the South End district. While no definite specifications have been adopted, the project calls for an initial investment of $200,000. Provisions for future expansion which would permit gradual enlargement of the plant to 200,000 or 250,000 hp. within the next eight or nine years will be made.

U. S. Road System Designated

Final location of the United States system of highways, consisting of approximately 80,000 miles of the most important roads in the country, has been made known by the U. S. Bureau of Public Roads. Final approval was given to the system by the American Association of State Highway Officials at its annual meeting at Pinehurst, N. C., on Nov. 11, 1929, but public announcement of the exact location of the routes has been withheld until maps could be prepared for distribution.

The system embraces ten main transcontinental routes, together with north and south routes, variants and crossovers reaching practically all of the larger cities and serving every section of the country. The system in its final form has the approval of each of the state highway departments and work on the unimproved sections is to be pushed rapidly.

No special funds are to become available as the result of the designation of any road as a part of the system. The purpose has been to select a main system of highways for the nation, the unimproved sections of which will be given priority in improvement, and to eliminate confusion as to route designation, marking and safety signs. Practically all of the roads are on the system of federal-aid highways and are eligible to receive federal aid.



WATERVILLE HYDRO-ELECTRIC DEVELOPMENT NOW IN SERVICE

This recently completed concrete arch dam on the Big Pigeon River, 12 miles above Waterville, N. C., part of the Waterville hydro-electric development of the Carolina Power & Light Co., is 180 ft. high and 870 ft. long along the crest. Water from the reservoir travels through a 6.2-mile pressure tunnel to a 108,000-kw. power plant. An account of the construction of the dam appeared in *Engineering News-Record*, June 6, 1929, p. 894.

Brief News

PENNSYLVANIA has arranged to purchase the New Holland turnpike, the last remaining toll road in that state, at a cost not exceeding $39,000.

ALL-STEEL ELECTRICALLY WELDED CONSTRUCTION will be used in building a 50-ton ship 65 ft. long, with a 20-ft. beam, now under construction in Milwaukee, Wis., for service on Lake Michigan.

COMMISSION GOVERNMENT was adopted by Union City, N. J., by a vote of 3,462 to 1,467 at a special referendum held April 22.

A NEW SAFETY RECORD has been set by the Middletown, Ohio, works of the American Rolling Mill Co., which, on April 22, had completed 1,300,000 man-hours without lost time because of an accident. On April 25 this record was still being increased.

THE CANADIAN NATIONAL RAILWAY has started a twice-a-week mixed freight and passenger train service over the Hudson Bay Railway between The Pas and Herchmer (Mile 412). Mixed trains will also be operated beyond Herchmer to Churchill, but not for regular passenger service.

TWIN STEEL BRIDGES are to be erected 200 miles apart on two of New Brunswick's scenic motor roads. The bridges are to be fabricated on identical designs, resulting in the saving of 15 per cent on the cost of the steelwork. The two contracts have been awarded to the Saint John Drydock & Shipbuilding Co., the approximate price of each structure being $37,000. Each bridge will have three 125-ft. riveted steel deck truss spans, and two 42-ft. deck girder spans, with cantilevered roadway and sidewalk.

EGYPTIAN PUBLIC WORKS orders to be placed during the first half of 1930 include the construction of irrigation works, hydro-electric power plants and railway construction to a total amount of approximately $15,000,000.

SKLERON, an aluminum-copper-zinc-lithium alloy with a tensile strength equal to steel, is now being used experimentally in building construction in western Germany. Although the material costs more than steel, its use is made economically possible by a saving in weight.

PERMISSION TO BUILD a $1,500,000 dam and water-works on the Sweetwater River has been requested of the California State Water Resources Commission by the Southern California Water Supply Co. The plan calls for the diversion of 18.6 sec.-ft. of water for domestic and irrigation purposes to be impounded behind a dam 204 ft. high and 800 ft. long.

VEHICULAR TRAFFIC using the ferry lines between San Francisco and Marin County, Calif., will be counted in an origin and destination check to be made by the California Railroad Commission upon the request of the Golden Gate Bridge and Highway District. The survey is being made to determine the approximate amount of traffic which would use a bridge over the Golden Gate.

Development of Pend Oreille by Two Dams Proposed

A radical alteration in the plans of the West Kootenay Power & Light Co., Rossland, B. C., for its proposed hydro-electric power development on the Pend Oreille River is indicated in its formal application filed recently with the British Columbia provincial government. Instead of the one 350-ft. dam originally planned, two dams are proposed, one 165 ft. high, at Seven Mile Creek, and another 150 ft. high at Cedar Creek, farther down the river. It is considered likely this change will reopen the long-drawn-out fight for water power between the West Kootenay company and the Reeves-McDonald mining interests, outlined in *Engineering News-Record*, March 13, 1930, p. 459. Authority to make surveys was granted to the West Kootenay company early in the year, on the condition that the company agree to supply power to the mining company.

Russian Railway Completed

The first Soviet-built railway, connecting Turkestan with Siberia, has recently been opened to traffic. The new road, approximately 1,700 miles long, was built in four years at a reported cost of $100,000,000. It runs parallel to the western boundary of China for about 700 miles, connecting the present Central Asia Railroad at Aris, Uzbekisan, with the Trans-Siberian Railway at Novosibirsk. From its southern terminus the new line gives access to existing roads running northwest into the Ural region and southerly to the borders of Afghanistan and Persia.

Inspection Services Organize

In order "to promote a proper understanding and co-operation among those engaged in or concerned with engineering inspection; to establish practices which will prove beneficial to proper service and to develop and encourage better and more effective inspection methods," an organization known as the National Engineering Inspection Association was recently formed at Detroit, Mich. The charter membership consists of twenty individuals, partnerships and corporations distributed throughout the country, and it is expected that a number of additional memberships will soon be secured. Officers elected were: president, Watson Vredenburgh, Hildreth & Co., Inc., New York City; vice-president, J. D. Stoddard, Detroit Testing Laboratory; secretary-treasurer, B. H. Witherspoon, Pittsburgh Testing Laboratory. The board of directors includes the officers and a representative from each of the four geographical sections of the country. The association plans to hold meetings semi-annually.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

House Passes Bill for Rivers and Harbors — Prospects for Other Engineering Legislation

WITHOUT a record vote the House passed the omnibus rivers and harbors bill on April 25, after having defeated repeated attempts by Representatives from states bordering on the Great Lakes to exclude the provision for the nationalization of the Erie Canal. Virtually the only change made in the bill was brought about by the adoption of a motion to strike out the section that authorizes Gen. Herbert Deakyne, the present assistant to the Chief of Engineers, to receive the rank and pay of a major-general when he retires from active service.

Opposition to the bill from Lake states Representatives was based on the fear that inclusion of the Erie Canal would jeopardize the carrying out of the St. Lawrence seaway project. Members from Michigan, Wisconsin and Minnesota expressed the opinion that the New York barge canal is a white elephant, and that even if the waterway is given to the United States, its maintenance expense will be prohibitive. Those sponsoring the nationalization of the Erie Canal made the contention that Canada is far from agreeable to the proposals for improving the St. Lawrence. Within two years after the Erie Canal is made a national waterway Canada will begin to be more willing to come to terms concerning the St. Lawrence, it was stated.

Flood-Control Funds

Immediate action is expected in the Senate on the War Department appropriation bill, which authorizes the expenditure of $35,000,000 to carry out work under the Mississippi flood-control act for the next fiscal year. An additional amount of $400,000 is made available for repair and maintenance of flood-control works on the tributaries of the Mississippi. An appropriation of $1,000,000 is allocated for flood-control work on the Sacramento River.

The War Department appropriations bill provided for a total expenditure of $456,243,386 as it passed the House. As reported to the Senate, the amount has been increased by $452,478. No changes were made by the Senate committee, however, in the sections of the bill dealing with the non-military activities of the Corps of Engineers. The $55,000,000 appropriation for rivers and harbors work that was indorsed by the House was left intact.

Reservoir Study Incomplete

The study of the possibilities of reservoirs in connection with flood control on the Mississippi River will not be ready for submission to Congress until Dec. 1. While the Chief of Engineers is ready to lay before the flood-control committee such data as have been gathered, should the committee request a report before the end of the present session, he will not be in a position to make a definite recommendation before the next Congress convenes. There is hope that the courts may be able to complete the interpretation of the compensation features of the law before that date. In that case the next Congress will have before it the information most needed for the intelligent amendment of the existing flood-control act.

General Brown regards it as fortunate that a legal interpretation of the act is well advanced. Had it not been for the action of the property holders in the Boeuf and Atchafalaya basins in contesting the compensation provisions of the law, there would have been no way in which court decisions affecting payment of damages could have been secured. Had work on the floodways advanced measurably before these studies were brought, costly delays would have resulted. By making these studies early in the life of the act it has been possible to concentrate funds and attention on the main river and the Bonnet Carré spillway, with the result that the so-called first lines of defense have been well advanced.

Hydraulic Laboratory Favored

To expedite the time of passage of the bill providing for the establishment of a national hydraulic laboratory in the Bureau of Standards and for the construction of a special building for the new institution, the commerce committee of the Senate has recommended the approval of the House bill, to be substituted for the bill passed by the Senate April 7. Differences between the two bills are relatively unimportant. The initial authorization for the laboratory is $350,000. The legislation is summarized in the committee's report as follows:

This legislation is intended to round out and complete the vast programs outlined

The Business Outlook

There has been some improvement in automotive requirements, chiefly from makers of low-priced cars. Pipe demand outside of merchant lines depending upon building construction is good. Tin plate and farm equipment continue active, and steel for highway construction purposes is in good demand. But railroad buying is light and falling off under the pressure of decreased traffic and earnings. Structural steel requirements are still relatively disappointing. Prices tend to weaken and there are rumors of wage reductions.

—The Business Week, April 30.

by Congress in recent years looking to the control of floodwaters, especially those of the Mississippi and its great tributaries, and improving rivers and harbors as aids to transportation; also to assist in the reclamation and irrigation of lands; the construction of canals and locks; the development of water power; navigation; stream gaging; erosion of coast lines; problems connected with water-supply and plumbing systems; and such machinery as turbines and pumps; also fundamental research in hydraulics, with the investigation of specific hydraulic problems for the federal government and for the general public. The bill has the hearty approval of American Engineering Council and the indorsement of the nation's leading scientists and hydraulic engineers.

Brown Opposes Reorganization of Power Commission

In reporting adversely on the Couzens bill proposing a reorganization of the Federal Power Commission, Major-Gen. Lytle Brown, Chief of Engineers, calls attention to the fact that he is expressing his individual view, as the proposed legislation had not been referred to the War Department by the interstate commerce committee. General Brown is quoted as follows:

I fear that two separate field forces, both engaged on the same work or on work that is so intimately connected as to be in effect the same work, will tend to cross-purposes, unalterable differences of opinion, friction, duplication of effort and possible delay. The creation of two engineer field forces reporting to separate heads is not calculated to result in coincident opinion, such as is the present plan of one field force. I am of the opinion that a field force not solely or vitally interested in power for itself alone is more likely to guard the public interest in general than is one whose sole interest will be in power.

Support for the Couzens bill is coming largely from the group advocating federal regulation of electric and gas services. Opposition to the measure has been growing in the Senate during the past week. Senator Ransdell, of Louisiana, who took an engineering course as a part of his schooling and who takes an active part in legislation pertaining to engineering or engineering bureaus, is opposing the measure actively.

Jurisdictional Strike Plan Prepared

A 90-day truce on jurisdictional disputes was asked by construction job employers and union leaders following a conference in Washington April 24. Within this period a practical plan will be submitted to set up a board for harmonious settlement. Since January groups have been meeting under a joint committee of the building trades department of the American Federation of Labor and the Association of Building Trades Employers. While a finished plan has not yet been drafted, it is obvious that the committee is almost ready to submit a proposal for some new form of agency to make jurisdictional awards and thus to minimize needless strikes. Unions have been given notice to say their last word as to amending the committee recommendations so far drafted. The committee is to meet again not later than July 26 to finally consider the plan and, if possible, to complete the set-up of the board.

Establishment of Engineering Experiment Stations Advanced

A favorable report was issued by the House agricultural committee on April 22 on the Haugen bill, providing for the maintenance of engineering experiment stations at the land-grant colleges. The measure now goes to the floor of the House, where it is believed that no opposition will be encountered, since the administration has indicated its approval. It is proposed in the bill to set up for the mechanics arts schools of the land-grant colleges experiment stations to do for mechanic arts and engineering what the agricultural experiment stations are doing for agriculture. The report issued by the House committee states that agriculture is now undergoing a transformation in which engineering is bound to play an increasingly important part. Control of erosion, improvement in machinery and better mechanical methods are some of the outstanding problems involved in the studies that it is planned to carry on.

To accomplish this purpose the bill provides for the payment by the federal government of one-third of the cost of maintaining the engineering experiment stations. The amount of federal money that would be allocated to each land-grant college is limited to $10,000 for the fiscal year ending June 30, 1932; $15,000 for the fiscal year ending June 30, 1933; $20,000 for the fiscal year ending June 30, 1934; and $25,000 for each succeeding fiscal year. It is specified that the states will have to donate three times the amount that the federal government appropriates each year.

Society Calendar

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; annual meeting, Atlantic City, N. J., June 23-27.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; annual convention, Cleveland, Ohio, July 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, St. Louis, Mo., June 2-6.

INTERNATIONAL CONGRESS OF BUILDING AND PUBLIC WORKS, London; fifth congress, London, England, May 26-30.

INTERNATIONAL RAILWAY CONGRESS, Madrid, Spain, May 5-15. American vice-president, T. S. Morgan, 119 West 42d St., New York.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston; annual meeting, Atlantic City, N. J., May 12-15.

WORLD POWER CONFERENCE, second plenary meeting, Berlin, Germany, June 16-25. American secretary, O. C. Merrill, Washington, D. C.

ILLINOIS SECTION, American Water Works Association, met in Chicago on April 23 and 24. Recognition of Chicago's importance as a railway center was reflected in a number of papers dealing with the problems of railway engineers in procuring and treating water for use in locomotives. The general problems of railway water service were described by J. P. Hanley, of the Illinois Central System. C. H. Koyl, of the Chicago, Milwaukee, St. Paul and Pacific, summarized at length development and present status of methods of water treatment for the prevention of scaling, pitting and foaming. A new plating medium for use in water laboratories was discused by Fred O. Tonney, of the Chicago Department of Health. The new medium makes possible direct differentiation between the colonies of B. Coli and B. Aerogones. For the ensuing year, Prof. M. L. Enger, University of Illinois, will be chairman of the section, and Chas. B. Burdick, consulting engineer, Chicago, vice-chairman. C. R. Knowles was selected as trustee of the national organization.

JEFFERSON AND LEWIS COUNTIES CHAPTER, New York State Society of Professional Engineers and Land Surveyors, was formed at a meeting held April 22 in Watertown. Officers elected are: president, William T. Field; vice-president, Oscar E. Hinds; secretary, J. Francis Larney, and treasurer, I. Wisner, all of Watertown.

MARYLAND-DELAWARE WATER AND SEWERAGE ASSOCIATION will hold its fourth annual conference May 13-14 at Hagerstown, Md.

MID-SOUTH SECTION, American Society of Civil Engineers, will hold its annual meeting May 15 and 16 at Little Rock, Ark. L. L. Hidinger, Memphis, is president and R. E. Warden, secretary-treasurer.

NATIONAL SAND AND GRAVEL ASSOCIATION board of directors will meet May 14-15 at Milwaukee, Wis., to select the city in which the 1931 annual convention will be held and to make arrangements for a trade practice conference to be held in connection therewith. The subject of uniform cost accounting will also be taken up.

NEW YORK SOCIETY OF THE PANAMA CANAL will hold its sixth annual banquet at the Hotel Astor, New York City, on May 3.

NEW YORK STATE SEWAGE WORKS ASSOCIATION will meet May 10 in Albany. A. S. Bedell, State Department of Health, is secretary.

Obituary

THOMAS FRANCIS MACDEVITT, construction engineer, superintendent of the George Hyman Co., of Washington, D. C., died at his home in Washington on April 17. He was 43 years old.

WILLIAM MORRISON ROBINSON, president and general manager of the Augusta & Summerville Railroad Co., formerly valuation engineer of the Georgia Railroad & Banking Co., died at his home in Augusta, Ga., on April 17. He was born in Fairfield District, S. C., in 1849, and had been in the practice of railroad engineering since a young man. He was a charter member of the American Railway Engineering Association.

PEMBERTON SMITH, retired civil engineer, died at his home in Larchmont, N. Y., on April 20, aged 64. After his graduation from Rennselaer Polytechnic Institute Mr. Smith spent six years as maintenance engineer with the New York Central and Pennsylvania railroads, then was with the Griffin Car Wheel Co. From 1902 to 1904 he was that company's European sales manager in London, Paris and Brussels. In 1904 he became general representative of the United States Steel Corporation, having charge of sales in Argentina, Uruguay and Paraguay. In 1917 he was engaged as New York manager in charge of European and some South American sales for the United States Steel Products Co., a subsidiary of the Steel Corporation. He retired from active business in 1924.

Construction Equipment and Materials

Water-Works Manufacturers to Exhibit at St. Louis

Products in the water-works field will be exhibited by the following firms at St. Louis, Mo., June 2-6, in connection with the annual convention of the American Water-Works Association:

American Brass Co.
American Cast Iron Pipe Co.
American Rolling Mill Co.
Atlas Mineral Products Co.
Automatic Cone Valve Co.
Badger Meter Mfg. Co.
Barber-Greene Co.
Bingham & Taylor Co.
Buffalo Meter Co.
Builders Iron Foundry
Central Foundry Co.
Chicago Bridge & Iron Works
H. W. Clark Co.
Columbian Iron Works
De Laval Steam Turbine Co.
Dorr Co.
East Jersey Pipe Co.
Eddy Valve Co.
Edson Mfg. Co.
Fairbanks Morse & Co.
Ford Meter Box Co.
Gamon Meter Co.
W. & L. E. Gurley
Hays Mfg. Co.
Hersey Mfg. Co.
Hydraulic Development Co.
International Filter Co.
Iowa Valve Co.
Johns-Manville Corp.
Kennedy Valve Mfg. Co.
Layne & Bowler Co.
Leadite Co.
Lead Lined Iron Pipe Co.
Lock Joint Pipe Co.
Ludlow Valve Mfg. Co.
McWane Cast Iron Pipe Co.
Michigan Valve & Foundry Co.
Mueller Co., Inc.
National Cast Iron Pipe Co.
National Meter Co.
National Tube Co.
National Water Main Cleaning Co.
Neptune Meter Co.
Omega Machine Co.
Paradon Mfg. Co.
Pitometer Co.
Pittsburgh-Des Moines Steel Co.
Pittsburgh Equitable Meter Co.
Joseph G. Pollard Co., Inc.
Rensselaer Valve Co.
Ross Valve Mfg. Co., Inc.
A. P. Smith Mfg. Co.
R. W. Sparling
U. S. Pipe & Foundry Co.
Vogt Bros. Mfg. Co.
Wailes Dove-Hermiston Corp.
Wallace & Tiernan Co., Inc.
Waterous Co.
R. D. Wood & Co.
Worthington Pump & Machinery Corp.

New Developments

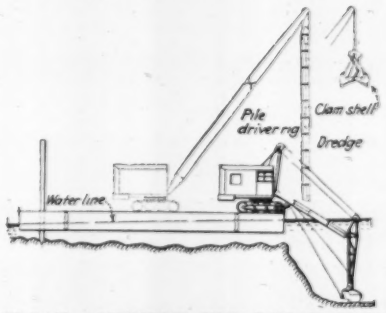
Rear Crawlers for Tractors

Improvements and refinements for the model TG rear type crawler treads for mounting on McCormick-Deering 10-20 industrial tractors have been announced by the W. A. Riddell Co., Bucyrus, Ohio. The new crawlers are fully equipped with ball and roller bearings, and are mounted upon the same tractor rear axle as are the rubber-tired wheels, so that the change from one type of mounting to another can be made in a short time. As each crawler is free to oscillate independently of the other and as the front of the tractor does not tip up when an obstacle is encountered, it is claimed that the rear type crawlers produce more satisfactory work with graders, bulldozers and other pieces of equipment working to close limits.

REAR CRAWLER MOUNTING ON INDUSTRIAL TRACTOR

Pontoons Transform Excavators to Marine Equipment

Recognizing the fact that the crawler crane and trench hoe can easily be adapted to do marine work, the Manitowoc Engineering Works, Manitowoc, Wis., has designed and patented a special hull for use with the Moore Speedcrane and attachments in waterway work. This device consists of four pontoons so designed and built that they can be readily shipped from point to point with the excavator, which is utilized in removing the units from the cars and assembling them in the water. Once assembled, the pontoons will support the excavator while engaged in building docks or marine foundations, in underwater trenching or similar undertakings. A small sectional dump scow for use with the units, to carry waste from excavations, is also available.



FLOAT ASSEMBLY FOR EXCAVATING EQUIPMENT

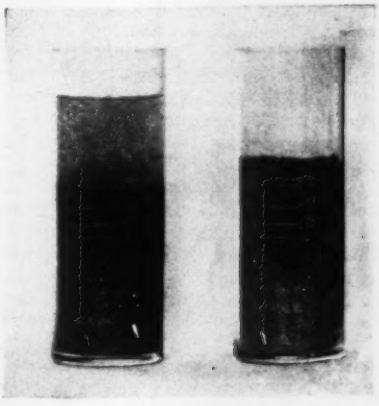
Perforated Curb Drains Streets

Something new in street-paving practice is being introduced by the Associated Engineering Development Corporation, New York City, in the form of draining curbstone, a precast hollow concrete block with frequent perforations designed to replace the present solid type of curbstone and eliminate the necessity for catchbasins. This is made of concrete, heavily reinforced with wire mesh and steel, with galvanized-steel curb guards when desired. Sections are made to standard or special specifications, including round and under-driveway units, the standard size being 5 ft. long, 6 in. wide and 18 in. deep. High strength and uniform dimensions are secured by a heat-treatment process of curing. The openings are so designed that they will admit material which will easily flow off into the sewer, but will hold back tin cans, dead animals and other refuse which should not be admitted to the sewer. It is claimed that by the use of this new curbstone street cleaning is greatly simplified, as 90 per cent of the street rubbish will be carried off by a simple flushing, leaving only a small amount to be gathered up by hand. Other advantages are quick drying of the street and elimination of the necessity of cutting a channel adjacent to the curbstone when removing snow.

PRECAST DRAINING CURBSTONE

Simple Device for Determining Bulking of Sand

Accuracy in proportioning concrete requires consideration of the effect of moisture in producing bulking of sand, usually determined by some form of inundating device. On many operations, however, an inundator is impracticable. Since, in cement-gun work, sand is used in a relatively dry state, this process cannot be used. To take its place, the Cement Gun Construction Co., Chicago, Ill., has devised a Bulkometer which has been tested by the Portland Cement Association and found to be accurate to within practical limits. It is simple and quick in operation. The device consists simply of a glass vessel with three columns of graduations to correspond to mixtures of 1:3 (commonly used for Guncrete), 1:2½:5, and 1:2:4. The instrument is filled to the top line with moist sand just as it comes from the pile, filled in loosely as it would go to a mixer. Water is then added and the

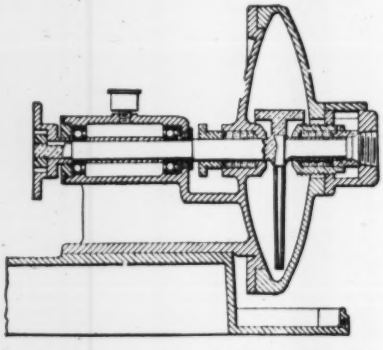


DETERMINING TRUE VOLUME OF MOIST SAND

sand thoroughly inundated and allowed to settle. The height of the sand indicates directly on the graduation the volume of sand which should be used to obtain a true mix of the proportions desired.

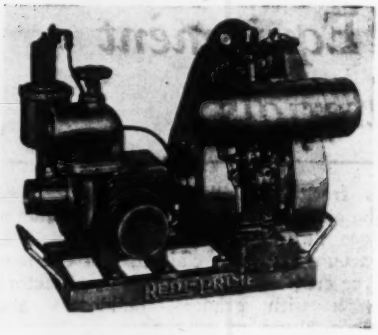
Self-Priming and Single Vane Centrifugal Pumps Announced

Two new types of centrifugal pumps developed by the American Steam Pump Co., Battle Creek, Mich., include a single-vane pump for handling small volumes of liquids at high pressures and a self-priming centrifugal pump in portable form. The former, known as type Q, is built in two sizes, both single-stage, for operation against heads up to 300 ft. It is intended for direct connection to standard-speed motors and is designed to maintain efficiency with gritty or corrosive water. The impeller consists of a single vane with knife edges, reducing disk friction to a minimum. The impeller and shaft, both of stainless steel, are welded together into one rigid unit, which is mounted on ball bearings outside of the pump casing. Since the shaft is short, it can be of small diameter without sacrificing strength or rigidity, which means a lower rubbing speed and reduced wear upon the packing. Short-circuiting of the liquid from the pressure side of the pump to the suction side is eliminated by means of a stuffing box of simple design. The packing in this box can be adjusted through a hand hole without disturbing the pump assembly or piping.



SECTION OF SINGLE VAN CENTRIFUGAL PUMP

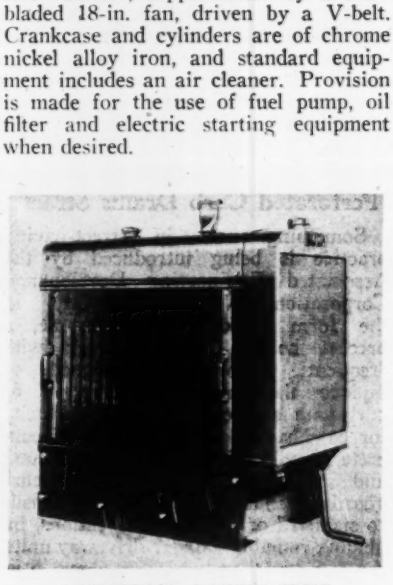
The portable centrifugal pump unit, known as the Redi-Prime, is a self-contained outfit weighing 115 lb. with a capacity varying from 6,500 gal. per hour at a head of 2 ft. to 1,500 gal. at 28 ft. The open-type bronze impeller will pass solids up to and including ½-in. diameter. Water can be lifted 22 ft. by suction and pumped against heads up to 35 ft. The pump has a dry system of automatic priming consisting of a small rotary air pump driven by a worm gear from the centrifugal pump shaft. This produces a positive vacuum in the casing as soon as the engine is started. After the centrifugal pump is primed, the air pump may be shut off by means of a hand lever. All bearings, the air pump, the friction clutch and the stuffing box operate in a bath of oil fed from one main oil reservoir. The stuffing box is equipped with a patented seal ring and requires no packing. Power is supplied by a four-cylinder Briggs & Stratton air-cooled gasoline engine rated at ¾ hp. which is direct-connected to the centrifugal pump by means of a flexible coupling.



PORTABLE SELF-PRIMING PUMPING UNIT

Power Unit of Compact Design

Light weight and small dimensions feature the model H-199 power unit announced by the Buda Co., Harvey, Ill., for industrial installation. Over-all dimensions are: width, 21 in.; height, 39 in.; length, 44 in. Power developed by this unit ranges from 16 hp. at 800 r.p.m. to 45 hp. at 2,000. The four-cylinder 3½x4½-in. engine has a piston displacement of 199 cu.in. It has a 3-in. crankshaft mounted on five main bearings. The lubricating system is designed to give a large quantity of oil at high velocity and uniform pressure. Efficiency is secured by eliminating excess water jacketing around the cylinder bores, overheating being prevented by a large-capacity water pump and an oversize radiator, supplemented by a four-bladed 18-in. fan, driven by a V-belt. Crankcase and cylinders are of chrome nickel alloy iron, and standard equipment includes an air cleaner. Provision is made for the use of fuel pump, oil filter and electric starting equipment when desired.



INDUSTRIAL POWER UNIT

New Publications

Power Excavators—The story of the development of the power shovel and the BUCYRUS-ERIE CO., South Milwaukee, Wis., is given in a 32-p. booklet recently issued by that company. Illustrations depict early excavators, manufacturing processes and job photographs in many parts of the world.

Drills—A new edition of bulletin 850 of the CHICAGO PNEUMATIC TOOL CO., New York City, is devoted to the one-man self-rotating hand hammer drill and accessories.

Road Machinery—Recent publications of the CATERPILLAR TRACTOR CO., San Leandro, Calif., include bulletins devoted to blade graders, elevating graders, maintenance machines and a condensed catalog of the entire Caterpillar road machinery line (formerly known as the Russell). Separate bulletins describe two new pieces of equipment, a road planer and a trailer patrol.

Tanks—A handbook on steel tanks, published by the LANCASTER IRON WORKS, INC., Lancaster, Pa., contains 91 pages of data on tank sizes and capacities, fire protection and insurance requirements for the storage of volatile liquids, specifications of steel for various purposes, and general useful information in connection with the design and installation of steel tanks.

Corrosion Resistant Alloys—Physical and chemical characteristics of stainless iron and steel alloys, particularly those containing chromium, are dealt with in considerable detail in a 21-p. booklet "Corrosion Resistant Alloys in General Fabrication," by T. H. Nelson, published by the DOWNINGTOWN IRON WORKS, Downingtown, Pa.

Curing Concrete—MCEVERLAST, INC., Los Angeles, Calif., has issued a 12-p. booklet on the Hunt process of curing concrete which describes the material and equipment used, gives details of the method of application and lists advantages to be obtained by the use of this process.

Surveying—A 10-p. pamphlet "The Parkhurst Vertical Collimator," written by George L. Hosmer, of the department of geodesy, Massachusetts Institute of Technology, and published by C. L. BERGER & SONS, INC., Boston, Mass., describes a new device for establishing a vertical line of sight. This was used in conjunction with portable steel triangulation towers by the U. S. Coast and Geodetic Survey on the Mississippi River flood-prevention control between Cairo and New Orleans.

Business Notes

INTERNATIONAL DERRICK & EQUIPMENT CO., Columbus, Ohio, has purchased the Leidecker Tool Co., of Marietta, whose plant will continue to operate under the same name.

INGALLS IRON WORKS CO., Birmingham, Ala., has purchased the plants of the Bollinger-Andrews Construction Co. and the Pennsylvania Fabrication Co. at Verona, Pa., in the Pittsburgh district. These plants are being extremely improved, with the addition of new machinery. The executive office of the company will remain at Birmingham, while the staff of engineers and estimators will be divided between that city and Verona.

MATERIAL AND EQUIPMENT INSPECTION BUREAU, Chicago, Ill., has been formed by Francis L. Harris and B. C. Rinehart to act as an agency for the inspection, purchase and liquidation of materials and equipment.

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR-BRAKE CO., Wilmerding, Pa., has been formed as a subsidiary of both the Bendix Aviation Corp. and the Westinghouse Airbrake Co. The new company will promote the use of air brakes in the automotive field. Officers are: president, Vincent Bendix; vice-president, S. G. Down; secretary-treasurer, W. J. Buettner; manager, R. M. Heinrichs.

REPUBLIC STEEL CORP. has announced executive sales appointments as follows: vice-president in charge of sales, H. T. Gilbert; assistant vice-president, A. E. Walker; sales manager of alloy steel products, J. M. Schlendorf; sales manager of mild steel products, Norman Foy.

BULLARD DAVIS, INC., of California, has resumed its former name of E. D. Bullard Co., effective April 1. The company has purchased the First Aid Equipment & Supply Co., Los Angeles. Manufacture of first-aid material and equipment will be continued at both San Francisco and Los Angeles.

The Business Side of Construction

Drop of First Two Months Is Being Made Up

APRIL contracts totaled $335,839,000, compared with $391,833,000 in March and $316,209,000 in April, 1929. Thus last month was 14 per cent under the record month and 6 per cent above the figure for a year ago. Each of these monthly totals included one or more jobs of outstanding size on which work may not start for several months. The March total included three buildings to cost $38,000,00 and $106,000,000 worth of A. T. & T. extensions. April included a $40,000,000 apartment development and a $30,000,000 office building of 83 stories for which subcontracts are expected to be let in October. Among the large contracts of April, 1929, were a $30,000,000 gas pipeline, two buildings for $34,000,000 and two subways for $14,000,000. Even subtracting these special jobs from the totals for their respective months leaves substantial totals: 248 millions for March, 266 for April and 240 for April, 1929.

The weekly average for April was 84 millions; for March, 98; for last April, 79; for the whole of 1929 it was 76 millions. The gain over last April was in both public and private work and was made in New York State. The figures for New England, the Middle West and the Far West are the same as last April. The South made the smallest showing.

The total for the first four months is 19 per cent below that of last year; but for the first two months the deficit was 43 per cent. New York State is nearly at last year's volume level. The deficit is quite equally distributed over the rest of the country. Public work is 18 per cent above, and private work 32 per cent below. Road lettings continue to gain. The April total of $54,289,000 is an increase of 20 per cent; for the four months the increase is 52 per cent. Other gains are 30 per cent for waterworks and 105 per cent for bridges. The total for sewers is within a million of last year and public buildings within four millions. Electric power plant contracts total $51,000,000, compared with $26,000,000 last year.

Employment Improves Slowly

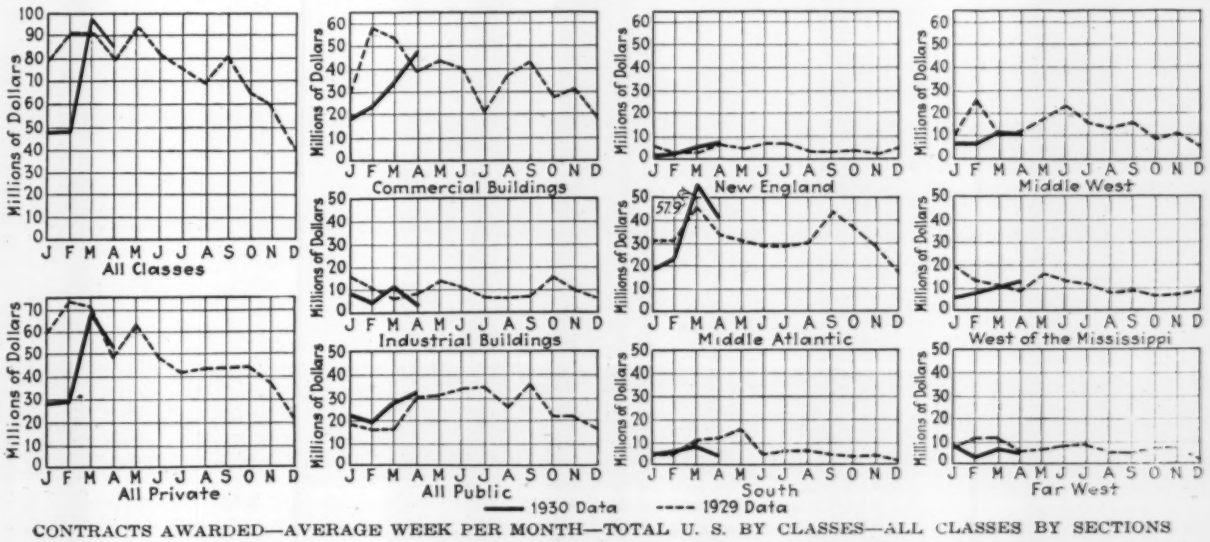
General employment throughout the country shows small improvement from a month ago, according to such figures as are available. Of the 850,000 building members of the A. F. of L., 40 per cent were not working at their trades in April, compared with 41 per cent in March and 43 per cent in February. One year ago the figure was only 29 per cent. It is probable that these percentages are reasonably accurate measures of the status of the nearly two million building mechanics outside the federation. There has been a small improvement, particularly in trades employed in engineering construction. This is largely, though not quite, offset by the continued depression in residential building and other small-job construction.

Manufacturing employment is lowest in the eight years which the government has maintained records. Figures for January, February and March were 89.3, 90.3 and 98.6; 1926 average 100.

VALUE OF CONTRACTS AWARDED IN THE UNITED STATES AND TOTAL FOR CANADA, APRIL, 1930

Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States April, 1930	United States Jan. 1–May 1 1930	United States Jan. 1–May 1 1929	Canada, April, 1930
Water-works	$250	$653	$701	$1,548	$700	$560	$4,412	$16,519	$13,311	$885
Sewers	189	1,491	727	2,182	414	348	5,351	24,657	24,741	110
Bridges, private	10	625		50	177		952	5,372	20,198	28
Bridges, public	200	7,367	905	691	1,545	368	11,076	33,415	19,420	162
Excavations	24		138	319	766	287	1,534	7,780	14,729	240
Streets and roads	3,754	13,882	6,989	10,214	14,876	4,574	54,289	160,339	105,178	3,834
Industrial buildings	3,476	3,118	1,437	1,674	4,062	5,107	18,874	125,239	191,272	1,358
Commercial buildings	9 551	108,528	6,205	12,715	9,887	10,356	157,242	419,132	652,189	3,140
Public buildings	5,236	18,779	1,034	4,907	3,429	861	34,246	103,968	106,986	150
Federal government	351	7,104	568	2,599	1,718	1,184	13,524	41,773	35,772	
Unclassified, private	1,229	370	887	12,923	9,879	257	25,545	181,860	212,109	114
Unclassified, public	840	5,731	157	378	351	887	8,344	41,492	42,246	1,427
April, 1930, 4 weeks	25,200	167,648	19,748	50,200	47,804	24,789	335,389			11,448
March, 1930, 4 weeks	20,093	231,695	31,814	41,279	42,994	23,958	391,833			17,751
April, 1929, 4 weeks	23,027	138,376	42,043	51,605	33,166	27,992	316,20			16,287
Jan. 1-May 1, 1930	61,340	590,633	95,860	150,121	154,003	109,589		1,161,546		57,081
Jan. 1-May 1, 1929	77,564	602,356	123,022	249,565	229,316	156,328			1,438,151	55,282



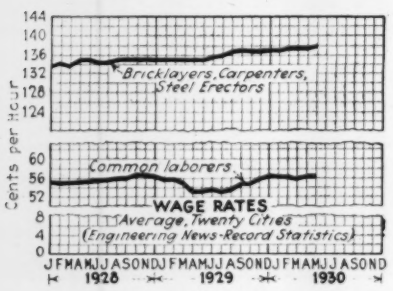
CONTRACTS AWARDED—AVERAGE WEEK PER MONTH—TOTAL U. S. BY CLASSES—ALL CLASSES BY SECTIONS

This is the first time since 1923 that the index has gone below 90. For March, only four of 26 industries reported improvement. These were paper and printing, petroleum refining, electrical machinery, and shipbuilding.

Payroll index numbers of 90.7 for February and 103.9 for March indicate a tendency toward full-time employment for individuals, which is hardly in line with earlier proposals to provide part employment for the largest number. Some Detroit automobile plants have been operating six days per week, giving the shifts three days. The Lone Star Cement Co. started the five-day week April 1 at its Bonner Springs (Kan.) mill, to continue throughout the year. The Canadian National Ry. shops are operating 40 hours per week. Some other local conditions are noted below.

Newark—Piledrivers and hoisting engineers on the Haynes Ave. viaduct struck because precast concrete piles used on the job were non-union made. Painters agreed to continue present wage rates until April 1, 1931.

New York—Strike of ironworkers on the Empire State Building over hiring of non-union men remains unsettled. This trade has operated here under open-shop conditions for 25 years, but the local trouble has affected projects in several other cities. Painters threaten strike in support of a strictly closed-shop policy in this trade locally. Carpenters claim that concrete-form erectors in subway construction receive $6.50 per day, while men performing this work on buildings are paid $12. A series of hearings are being held in order definitely to settle this claim.


Cents per hour
Bricklayers, Carpenters, Steel Erectors
Common laborers
WAGE RATES
Average, Twenty Cities
(Engineering News-Record Statistics)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

Morristown—Carpenters' demand for a five-day week was rejected by employers in five municipalities in this district of New Jersey.

Asbury Park—Union electricians on beach-front improvements demanded $1.20 per day increase (the New York rate) with five-day week. Contractors refused the demand and placed non-union men on most of the jobs.

Philadelphia—Carpenters have been granted the five-day week as a trial for June, July and August, with continuation of present wages and the closed shop. Men seek five-year agreement.

Waterbury (Conn.)—Painters struck because five-day week grant did not carry increased wage rate. Employers threaten open shop.

Lowell (Mass.)—Strike of bricklayers settled by award of 5c. (to $1.50) and five-day week. Men had demanded $1.65.

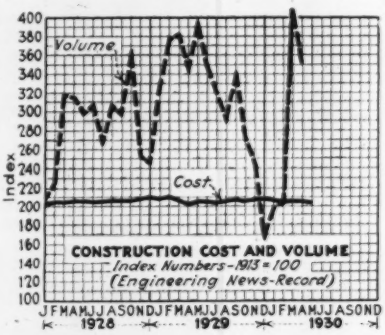
St. Louis—Granite cutters struck April 2 for wage increase of 12½c. (to $1.25) and five-day week. A year ago the granite cutters lost a strike on these grounds. Piledrivers and cement finishers demand an increase of 25c. (to $1.50) effective July 1. Employers hold times impropitious for higher labor costs.

Chicago—Structural ironworkers rejected proposal submitted to them by the contractors, which would maintain present rates for the term of the contract. The union demands an advance of $1 per day, to $14.

Average Wages—The rate for skilled construction labor is $1.38⅜ per hour, against $1.37⅜ in April and $1.35½ in May, 1929. Common labor is 56.28c. per hour, compared with 56.46c. in April and 53.15c. in May, 1929.

Construction Cost and Volume Index Numbers

Decreases in lumber and common labor rates reduced costs 0.5 per cent from April 1. The common labor rate is 56.28c., compared with 56.46c. last month. The volume index is 14 per cent less than for March and 5.7 per cent above April, 1929. It is fourth highest of the last sixteen months.


Volume
Cost
Index
CONSTRUCTION COST AND VOLUME
Index Numbers-1913=100
(Engineering News-Record)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

E. N.-R. Cost		E. N.-R. Volume*	
May, 1930	**205.86**	**Apr., 1930**	**351**
Apr., 1930	207.12	Mar., 1930	408
May, 1929	205.15	Apr., 1929	332
Peak, June, 1920	273.80	1929 (average)	317
1929 (average)	207.02	1928 (average)	287
1913 (average)	100.00		
1929		1929	
January	209.40	January	325
February	210.40	February	378
March	207.78	March	382
April	203.40	April	332
May	205.15	May	395
June	205.65	June	347
July	204.77	July	320
August	205.91	August	290
September	207.57	September	340
October	206.32	October	273
November	208.46	November	245
December	209.46	December	166
1930		1930	
January	208.96	January	199
February	206.46	February	204
March	206.80	March	408
April	207.12	April	351

*Corrected for price change since 1913.

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Advances since last month are indicated by **heavy type**, declines by *italics*

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor*
Atlanta	$1.25@1.40	$0.60@.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.75	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.25	.20@.35
Boston	1.50	1.37½	1.37½	.85	1.27½	1.37½	.45@.80
Cincinnati	1.62½	1.40	1.40	1.00	1.40	1.40	.40@.60
Chicago	1.70	1.62½	1.62½	.97½	1.62½	1.62½	.97½
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.40@.87½
Dallas	1.67½	1.12½	1.25	.35 @ .75	1.25	1.25	.35@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	.....	1.25	.62½
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City	1.50	*1.25*@1.37½	1.25@1.37½	.90	1.25	1.37½	.35@.75
Los Angeles	**1.37½**	1.00	1.00	*.75*	.87½	**1.12½**	*.37½*@.50
Minneapolis	1.25	.87½@.95	.87½	.75	.....	1.00	.45@.60
Montreal	1.25	.80	.75	.....	.90	1.00	*.30*@.35
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.87½	1.65	1.92½	1.18¾	1.10@1.23½	1.92½	1.03½
Philadelphia	1.75	1.50	1.02½	*.70*@1.12½	1.00	1.37½@1.50	.40@.50
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.40@.80
St. Louis	1.75	1.50	1.60@1.75	**1.25@1.50**	1.25	**1.75**	**.45@.87½**
San Francisco	1.37½	1.12½	1.12½	.87½	1.12½	1.37½	.68¾
Seattle	1.50	1.12½	1.12½@1.25	1.00	1.12½	1.25	.70

*Minimum rates are non-union and for construction other than buildings.

Notes on Materials Prices

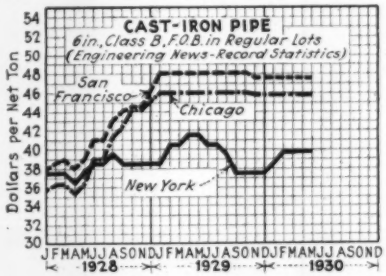
New steel freight rates become effective as noted here on April 3. Pittsburgh makers oppose the new schedule, in which reductions outnumber advances 8 to 1, claiming that the advances will transfer leadership to Chicago.

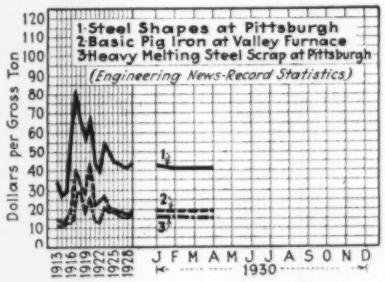
Change in steel-pipe discounts on the April Pittsburgh basing card gave the jobbers an advantage of about two points on carload business. In most of the cities dealers have increased discounts to consumers by about the same margin at mill. The reason seems to be (1) cutting under by the Steel Corporation because of the proposed Bethlehem-Youngstown merger and (2) increasing use of the lower-cost electric welding method. Consumption is increasing.

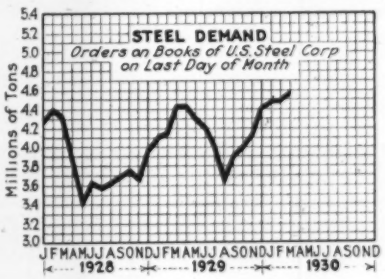
The largest contract in April was for a $16,000,000 gas pipeline of 950 miles from Texas Panhandle to Indiana and Illinois. This is the longest line since the 1,400-mile job in Louisiana, Alabama and Georgia, awarded last year for $35,000,000. Proposed gasoline pipelines between refineries and large consumption points will add further to the heavy demand already created by oil and gas.

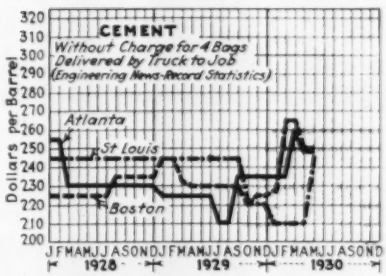
With most of the larger tonnages of reinforcing bars for the road programs placed, price cutting is reported. On stock lengths at Pittsburgh the current price is $1.85, compared with $1.96 in April and $2 in May, 1929.

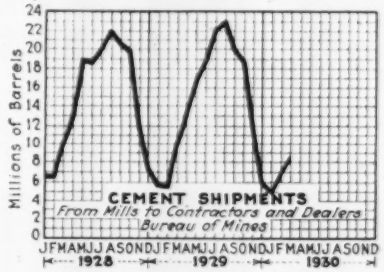
A sign of improvement in building is seen in heavier orders for steel sheets used as lath stock. Metal lath prices dropped sharply at Chicago and St. Louis during April, but held firmly in the other cities. Other sheets are not moving as rapidly, business in corrugated galvanized roofing being particularly slow.




1 Steel Shapes at Pittsburgh
2 Basic Pig Iron at Valley Furnace
3 Heavy Melting Steel Scrap at Pittsburgh
(Engineering News-Record Statistics)
Dollars per Gross Ton
1930







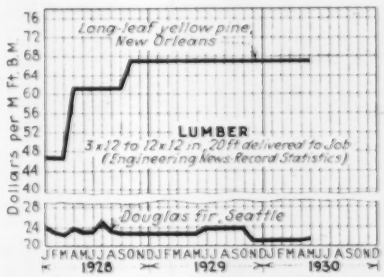
Steel sheetpiling orders are increasing at mills. Backlogs are light on almost all items, as are consumers' stocks. Dealers' stocks, on the contrary, are larger than a year ago in steel as well as all other metals.

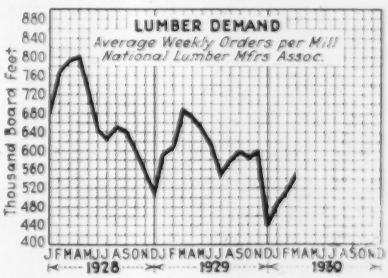
Structural steel prices are $1.75 for large lots to $1.80 for small. Lots as small as a carload have recently been purchased at the higher figure. A month ago $1.80 was the minimum; in May, 1929, the price was $1.95.

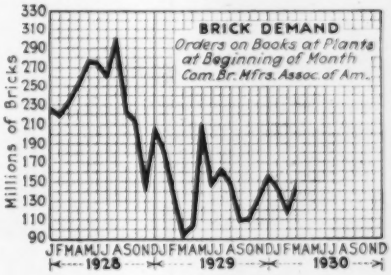
Paving materials prices are steady, with satisfactory consumption in prospect. City paving in municipalities of 100,000 inhabitants or more amounted to 45,000,000 sq.yd. in 1929, or 11 per cent more than for 1928. The Asphalt Institute in presenting these figures predicts that 1930 paving will exceed last year's by 15 to 20 per cent.

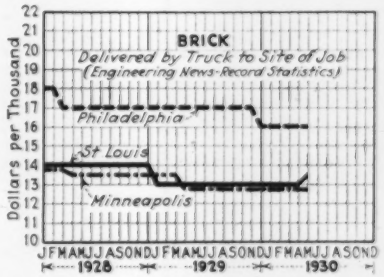
An unfavorable feature of the lumber situation is accumulating stocks at wholesalers' yards in the metropolitan area, due to the depression in residential building.

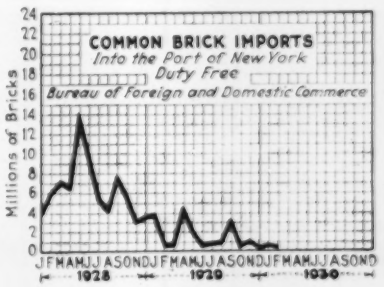
Brick dealers say that prices have been "scraping bottom" and present figures will probably hold for a while. Active buying is hardly expected before autumn.











	Cumulative 1930	Cumulative 1929	Per Cent Change
Lumber, M. ft., b.m. (softwoods)			
Production, 16 weeks	4,233,231	4,720,526	—10.0
Shipments, 16 weeks	4,178,783	4,946,531	—16.0
Orders, 16 weeks	4,182,860	5,188,464	—19.0
Unfilled orders at end of 16 weeks	862,388	1,285,403	—32.9
Stocks at end of 16 weeks	3,098,736	2,591,503	+19.3
Cement, barrels			
Production, 3 mos.	27,885	28,372	— 1.7
Shipments, 3 mos.	20,813	21,268	— 1.8
Stocks at end of 3 mos.	30,563,000	29,724,000	+ 2.6
Brick, common, number			
Stocks, burned, at end of 2 mos.	513,057,000	366,150,000	+40.1
Shipments, 2 mos.	133,641,000	190,461,000	—30.0
Unfilled orders, at end of 2 mos.	140,451,000	91,615,000	+53.2
Steel, ingots, tons			
Production, tons, 3 mos.	12,143,275	13,874,612	—12.3
Fabricated Structural Steel, tons			
Orders, 3 mos.	772,000	897,050	—13.9
Shipments, 3 mos.	812,000	796,950	+ 2.0
Fabricated Steel Plate, tons			
Orders, 3 mos.	114,393	149,117	—23.4

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per barrel, *without charge for bags*, cash discount not deducted. Prices marked f.o.b. are manufacturers'; others are delivered by truck to contractors:

	May. 1, 1930	One Mo. Ago	One Yr. Ago
Atlanta	$2.49	$2.49	$2.25
Baltimore	2.60	2.60	2.65
Birmingham	2.60	2.60	2.60
Boston	2.50	2.50	2.25@2.35
Dallas	2.15	2.15	2.15
Denver	2.61	2.61	2.55
Jersey City	2.60	2.60	2.25
Kansas City	2.65	2.65	2.55
Los Angeles	1.92	1.92	2.76
Montreal	2.20	.....	.....
New Orleans	2.65	2.65	2.65
New York	2.30	2.30	2.25
Philadelphia	2.10	2.10	2.40
St. Louis	2.45	2.45	2.45
San Francisco	2.64	2.64	2.41
Seattle (F.O.B.)	2.70	2.70	2.70
Cedar Rapids	2.23	2.23	2.24
Chicago	1.95	1.95	2.05
Cincinnati	2.14	2.14	2.22
Cleveland	2.04	2.04	2.24
Davenport	2.14	2.14	2.24
Detroit	1.95	1.95	1.95
Duluth	2.04	2.04	2.04
Indianapolis	1.99	1.99	2.09
Milwaukee	2.10	2.10	2.20
Minneapolis	2.27	2.27	2.22
Peoria	2.12	2.12	2.22
Pittsburgh	1.95	1.95	2.05
St. Paul	2.27	2.27	2.22
Toledo	2.20	2.20	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b.:

Alpena, Mich.	$1.65	Limedale, Ind.	$1.70
Buffington, Ind.	1.70	Mason City, Ia.	1.85
Hannibal, Mo.	1.80	Norfolk, Va.	1.90
Houston, Tex.	1.95	North Birmingham, Ala.	1.70
Hudson, N. Y.	1.85	Richard City, Tenn.	2.05
Ironton, Ohio	1.75	Steelton, Minn.	1.85
Iola, Kan.	1.85	Universal, Pa.	1.70
La Salle, Ill.	1.80	Wyandotte, Mich.	1.70
Lehigh Valley District	1.75		

SAND AND GRAVEL—Per ton, delivered by dealers. Weight of sand per cu.yd. 1½ tons; gravel, 1½ tons, unless otherwise specified in pounds:

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta	$2.60	$2.60	$2.15
Baltimore	2.40	2.60	1.70
Birmingham, per cu.yd., 2,600 lb.	3.50	3.50	3.00
Boston	1.90	1.90	1.25
Chicago, per cu.yd.	1.90	1.90	1.80
Cincinnati	1.75	1.75	1.50
Cleveland, per cu.yd., 3,000 lb.	2.70	2.70	2.50
Dallas, per cu.yd.	2.60	2.60	2.60
Denver, per cu.yd., 2,700 lb.	**1.95**	**1.95**	**1.35**
Detroit, per cu.yd., 2,600 lb.	3.25	3.25	2.75
Kansas City	1.50	1.50	1.35
Los Angeles	1.40	1.40	1.00
Minneapolis, per cu.yd., 2,800 lb.	2.40	2.40	1.10
Montreal	1.25	1.25	1.25
New Orleans, per cu.yd., 2,700 lb.	3.75	3.75	2.75
New York, per cu.yd.	3.40	3.40	2.15
Philadelphia	2.30@3.15	2.30@3.15	1.50@2.31
Pittsburgh	2.20	2.20	2.40
St. Louis	2.25@2.35	2.25@2.35	2.00
San Francisco	1.75	1.75	1.75
Seattle, per cu.yd., 3,200 lb.	1.75	1.75	1.75

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Per ton, delivered by dealers. Weight per cu.yd., 1½ tons, unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta	$2.60	$2.60
Baltimore	2.75	2.85
Birmingham, Limestone, per cu.yd.	3.00	3.25
Boston	2.10	2.10
Chicago, Limestone, per cu.yd., 2,500 lb.	1.90	1.90
Cincinnati	2.25	2.25
Cleveland	2.70	2.70
Dallas, per cu.yd., 2,500 lb.	3.25	3.40
Denver, Granite, per cu.yd., 2,700 lb.	2.50	2.50
Detroit, Limestone	3.00	3.00
Kansas City, Limestone	2.60	2.60
Los Angeles	1.50	1.50
Minneapolis, Limestone, per cu.yd., 2,600 lb.	2.40	2.40
Montreal	1.90	2.10
New York, Limestone, per cu.yd.	3.40	3.40
Philadelphia, Limestone	2.30@3.15	2.30@3.15
Pittsburgh	2.75	2.75
St. Louis	1.90	1.90
San Francisco, Trap rock	1.65	1.65
Seattle, per cu.yd., 2,700 lb.	1.90	1.90

CRUSHED SLAG—Manufacturers' quotation on crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala.	$0.90	$1.15	$2.05	$0.55
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.35	1.35	.....	.80
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Building tile per block, delivered by dealers to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.069	$0.091	$0.125	**$0.157**	$0.178
Baltimore	.105	.....	.20	.....	.26
Birmingham	.09	.127	.174	.218	.261
Boston	.086	.113	.155	*.1*	.26
Chicago	.076	.104	.142	.182	.202
Cincinnati	.068	.095	*.129*	*.165*	.184
Cleveland	.064	.088	.128	.171	.19
Dallas	.074	*.112*	*.159*	.251	.296
Denver	.0975	.135	.175	.2125	.25
Detroit	.098	.135	.184	.24	.265
Kansas City	.0525	.077	.184	.24	.265
Los Angeles	.085	.122	.175	.232	.285
Minneapolis	.0611	.081	.10605	.1302	.1737
Montreal	.12*	.....	.22†	.....	.....
New Orleans	.086	.118	.16	.212	.256
New York	.0864	.1296	.162	.....	.....
Perth Amboy, N. J. (f.o.b.)	.....	.....	.....	.2388	.2956
Philadelphia	.105	.14	.215	.28	.34
Pittsburgh	.068	.....	.1175	.....	.1726
St. Louis	.078	.104	.145	.175	.21
San Francisco	.108	.156	.255	.....	.....
Seattle	.085	.115	.18	.....	.....

*4x4x12. †8.8x12.

BRICK—Prices delivered by dealers per thousand, are as follows:

	Common	Paving F.O.B. 3x8½x4-In.	Paving F.O.B. 3½x8½x4-In.
Atlanta	$12.00	$36.00*	$42.00†
Baltimore	13.00	40.00	46.00
Birmingham	14.00	26.00*	31.00†
Boston	17.00	43.00	47.00
Chicago	12.00	42.00	45.00
Cincinnati	17.50	37.00	39.00
Cleveland	14@16	33.00	36.00
Dallas	*14.50*	**30.00***	.....
Denver	11.00	.....	.....
Detroit	15.50	33.50	36.50
Kansas City	14.00	.....	.....
Los Angeles	9.00	.....	.....
Minneapolis	12.75	.....	.....
Montreal	20.00	.....	.....
New Orleans	16.50	38.00*	45.00
New York	15.00	45.00	50.00
Philadelphia	16.00	40.00	46.00
Pittsburgh	16.00	40.50	45.00
St. Louis	13.50	40.00	40.00
San Francisco	14.50	45.00*	.....
Seattle	14.00	50.00	55.00

*2½x8½x4 in. †3.8.x4.

LIME—Prices delivered by dealers to job:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
Atlanta	$21.00	$13.50	.....	.....
Baltimore	22.00	14.00	$2.55†	.....
Birmingham	22.00	16.00	3.00†	$2.00†
Boston	22.00	15.00	4.00*	3.15*
Chicago	17.00	14.50	15.00‡	1.50†
Cincinnati	15.80	13.00	.....	.....
Cleveland	18.00	15.00	2.50†	2.50†
Dallas	20.00	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	18.00	14.80	2.20†	2.00†
Kansas City	*16.00*	*12.50*	2.85†	2.50†
Los Angeles	18.90	16.00	2.85†	14.00‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	19.75	.....	.....	15.00‡
New Orleans	.....	.....	2.60†	1.60†
New York	21.00	14.00	4.10*	3.15*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	20.00	18.00	2.50†	.....
St. Louis	24.00	18.00	2.75†	15.00‡
San Francisco	20.00	20.00	2.00†	1.70†
Seattle, paper sacks	36.00	24.00	.....	2.80†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Manufacturers' quotations on standard, 8x8x16-in., hollow, delivered to job, each:

Boston	$0.18@$0.20	Minneapolis	$0.15
Brooklyn and Queens	.12@ .14	New Orleans	.22
Cleveland	.16@ .17	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.20
Detroit	.15	St. Louis	.18

SLATE—Roofing, f.o.b., quarry, Bangor, Pa., net, per square:

No. 1 Clear	$9.45@$13.05
No. 1 Ribbon	8.10@ 9.23
Medium Clear	8.55@ 10.13

Road and Paving Materials

PAVING STONE—Carloads or cargo lots of granite blocks, 4x8x4-in. dressed, f.o.b.:

Atlanta	$3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Boston	135.00 per M.
Chicago, 5 in.	3.25@3.90 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	115@120 per M.
Detroit, 5 in.	3.00 per sq.yd.
Kansas City	3.00 per sq.yd.
Minneapolis, 4½x8x5 in.	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in., Grade 1, 30 blocks per sq.yd.	150.00 per M.
Philadelphia	125.00 per M.
St. Louis, 4x5x8 to 12 in.	3.50 per sq.yd.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices, f.o.b., in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.25
Chicago	3½	12	2.10
Cincinnati	3½	16	2.35
Kansas City	3½	16	2.75
Minneapolis	3½	16	2.75
Montreal	4	16	4.50
New Orleans	3½	16	2.40
New York	3½	16	2.70
St. Louis	3½	16	2.40

FLAGGING—Alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, 5x16 in., rough, 90c. per lin.ft.; cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St. Louis*: Class "B" straight, 5x16-in., f.o.b., $1.00 per lin.ft.; roundings, *$1.35* per lin.ft.

ASPHALT—Manufacturers' quotations per ton in packages (350-lb. bbls. or 425-lb. drums); also in tank-car lots, f.o.b. points listed:

	Package	Tank-car
Atlanta (Mexican)	$20.40	$16.40
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	23.00
Boston (Mexican)	23.50	18.00
Chicago (Texas)	23.50	19.30
Cincinnati (Kentucky Rock)		12.30
Cleveland	24.00	20.00
Dallas (Texas)	**25.25**	
Denver (California)	35.00	
Detroit (Mexican) (Texas)	19.72	14.87
Kansas City, Mo. (Texas)	*23.50*	*17.00*
Los Angeles ("D" Grade, Calif., f.o.b., El Segundo)	18.00	12.00
Maurer, N. J. (Bermudez)	30.00	
Maurer, N. J. (Trinidad)	25.00	
Minneapolis, (Stanolind, f.o.b., Twin Cities)	23.00	19.10
Montreal (Imperial)	28.00	21.50
New Orleans (Texas)	24.00	21.00
New York (Texas)	22.50	18.50
Philadelphia (Mexican)	18.00	15.00
Pittsburgh (Standard Oil)	24@26	14@18
St. Louis (Venez.)	22.50	18.50
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle, ("D" grade, Calif., f.o.b. Richmond)	18.00	12.00

ROAD OILS—Manufacturers' quotations, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0.0525
Birmingham, 50@60% asphalt	.0525
Dallas, 40@50% asphalt	**.055**
Dallas, 50@60% asphalt	**.055**
New York, 40@50% asphalt, (at terminal)	.05
New York, 50@60% asphalt, (at terminal)	.05
St. Louis, 40@50% asphalt	.04
St. Louis, 50@60% asphalt	.04

Iron and Steel

PIG IRON—Producers' quotations, per gross ton, f.o.b.:

Birmingham, No. fdry., silicon 1.75@2.25	$15.00
Pittsbhrgh, basic, incl. freight ($1.76) from Valley	20.26

STRUCTURAL STEEL—Manufacturers' and dealers' quotations per 100 lb.

	Shapes, 3 to 15-In.	Plates, ¼-In.
Birmingham, large mill lots, f.o.b.	$2.15	$2.15
Chicago, warehouse, delivered	3.10	3.10
Cleveland, warehouse, delivered	3.00	3.00
Dallas, warehouse, delivered	3.65	3.65
New York, warehouse, delivered, up to 3,999 lb.	3.30	3.30
Pittsburgh, large mill lots, f.o.b.	1.80	1.80
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	3.40	3.40

BARS, CONCRETE REINFORCING—Manufacturers' and dealers' quotations on bars rolled from billets, per 100 lb. for ½-in.:

Birmingham, large mill lots, f.o.b.	$2.15
Chicago warehouse, delivered	2.15@3.00
Cleveland, warehouse, delivered	2.25@2.44
Dallas, warehouse, delivered	**3.50**
New York, warehouse, delivered, over 5 tons	2.70
Pittsburgh, large mill lots, stock lengths, f.o.b.	*1.85*
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.25

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered to job, in less-than-carload lots:

Lb. per Sq.Yd.	New York	Bir-mingham	Chicago	St. Louis	Dallas	San-Francisco
2.2	$18.50	$22.00	*$16.00*	*$18.00*	**$21.50**	$21.50
2.5	19.50	23.00	*17.00*	*19.00*	**24.00**	22.50
3.0	21.00	25.00	*18.50*	*20.50*	**25.50**	25.00
3.4	22.00	26.50	*19.50*	*21.50*	**30.00**	27.00

WIRE REINFORCEMENT FOR CONCRETE—Manufacturers' quotations per 100 sq.ft. in carloads at mills; and delivered by dealers, in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pitts-burgh Mill	Chicago District Mill	New York	St. Louis	Dallas	San Fran-cisco
				Warehouse Delivery			
032	22	$0.99	$1.01	$1.39	$1.45	$1.13	$1.22
049	28	1.26	1.29	1.76	1.80	1.38	1.55
068	35	1.54	1.58	2.18	2.25	1.67	1.91
093	40	1.98	2.03	2.79	2.90	2.00	2.46
126	57	2.45	2.51	3.45	3.55	2.55	3.03
153	68	2.92	2.99	4.13	4.25	3.15	....
180	78	3.35	3.43	4.73	4.85	3.47	....

STEEL SHEETS—Manufacturers' and dealers' quotations per 100 lb. base:

	Blue Annealed No. 10*	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3.35†	$4.05†	$4.60†
Cleveland, warehouse, delivered	*3.25*	3.75	4.50
New York, warehouse, delivered	*3.50@3.60†*	*3.65@3.90*	*4.25@4.50*
Pittsburgh, large mill lots, f.o.b.	2.10	*2.55@2.65*	3.30@**3.40**
St. Louis, warehouse, delivered	3.45	4.25	4.85
San Francisco, warehouse, delivered	4.00	4.70	5.10

*Light plates. †400 lb. to 3,999 lb.

WIRE ROPE—Discounts from manufacturers' list price on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (add to list)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	5%
"Special Steel" and extra strong cast steel, round strand rope	27½%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Manufacturers' and dealers' quotations on structural rivets, round-head, ½-in., full kegs, per 100 lb.:

Chicago, warehouse, delivered	$4.00
Dallas, warehouse, delivered	4.50
New York, warehouse, delivered	4.50*
Pittsburgh, large mill lots, f.o.b.	3.10
St. Louis, warehouse, delivered	4.15
San Francisco, warehouse, delivered	**5.00**
Seattle, warehouse, delivered	4.25

*This price is for full kegs; broken kegs are $6.00 per 100 lb.

STEEL SHEETPILING—The manufacturers' base price, f.o.b., Pittsburgh, for large mill lots is $2.25 per 100 lb.

TERNE PLATE—I C, 8-lb. coating, 20x28-in., f.o.b., Pittsburgh mill:

Per package	$10.70

SHIP SPIKES—Per 100 lb., black, from dealers' warehouse stocks; galvanized are about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	$5.55	$5.10	$4.95
Seattle	7.75	5.65	5.50

Pittsburgh mill base in lots of 200 kegs or more, $3.00 per 100 lb.

WIRE NAILS—Per 100 lb. keg, base, delivered from warehouse stocks; also Pittsburgh mill base:

Pittsburgh Mill	Birming-ham	Chicago	St. Louis	Dallas	San Francisco	Montreal
$2.30@$2.40	$3.30	$2.85	$2.85	$3.75	$3.25	$4.95

SCRAP—The prices following are, f.o.b., per ton, paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	*$11.75*	**$13.00@$13.50**	$12.50@$13.00
Stove plate	*7.50@* 9.00	11.00@ 11.50	10.00
No. 1 machinery cast	10.85	14.00@ 14.50	12.00*
Machine shop turnings	*6.50@ 7.00*	7.50@ 8.00	8.25
Cast borings	*7.00*	9.50@ 10.00	9.50
Railroad malleable	*11.50@ 12.00*	*16.25@ 16.75*	13.00
Re-rolling rails	10.50@ 11.00	15.00@ 15.50	13.00
Re-laying rails, 56@60 lb.	23.00@ 24.00	20.00@ **25.00**	.....
Heavy melting steel, No. 1	*10.00@11.25*	13.00@ 13.50	12.25
Iron and steel pipe	*9.25*	*8.50@ 9.00*	9.50@ 10.00

*Net ton.

FREIGHT RATES—Effective May 20, 1930, on finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished) chains, etc., the following freight rates in cents per 100 lb., apply on carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	*$0.265*
Baltimore	.27	Kansas City	.71†
Birmingham	.58	New Orleans	.67
Boston	**.40**	New York	*.43*
Buffalo	*.235*	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	*.29*
Cincinnati	*.265*	St. Louis	*.39*
Cleveland	*.185*	St. Paul	.60
Denver	1.15*		

*Minimum weight on structurals, 60,000 lb. †Except iron or steel pipe and fittings.

Railway Materials and Supplies

STEEL RAILS—Manufacturers' quotations per gross ton, f.o.b., for large mill lots:

	Pittsburgh	Birmingham	Chicago
Standard openhearth rails	$43.00	$43.00	$43.00
Light rails, 25 to 45 lb.	36.00	34@36	34@36
Re-rolled rails	34.00	34@36	34@36

RAILWAY TIES—For fair-sized orders, f.o.b., the following prices per tie hold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.25
	Creosoted—prices on application.		
Birmingham	White oak, creosoted	1.52	1.75
	Southern pine, creosoted	1.25	1.60
	White oak, untreated	1.40	1.78
Chicago	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
	Southern pine, creosoted	1.60	2.10
	White oak, untreated	1.05	1.50
St. Louis	Red oak, creosoted	1.40	1.90
	Sap pine or cypress, untreated	.85	1.20
San Francisco	Douglas fir, green, untreated	.87½	1.21
	Douglas fir, empty cell, creosoted	1.60	2.10
Montreal	Birch or maple, untreated	.75@1.25	.75@1.25
	Birch or maple, creosoted	1.20@1.30	1.50@1.60

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Manufacturers' and dealers' quotations per 100 lb. f.o.b., Pittsburgh mill, for large mill lots, together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, ⅝-in. and larger	$2.80	$3.55	$3.45	$3.75@$3.85	$4.35
Track bolts	3.80@4.00	4.55	5.85	4.85@ 4.95	5.85
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.75	.....	.....

Tie plates: Price at Pittsburgh mill, $2.07½ per 100 lb.

Pipe

WROUGHT-STEEL PIPE—Discounts from manufacturers' and dealers' standard lists:

	1 to 3-In. Butt Weld		3½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	57.3%	44.8%	53.9%	41.4%
Cleveland, warehouse, delivered	53.5%	42.3%	53.3%	40.3%
New York, warehouse, delivered	56.03%	43.48%	52.66%	40.06%
Pittsburgh, large mill lots, f.o.b.	61%	52.5%	61%	49.5%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Prices of U. S. Pipe & Foundry Co., per net ton, for bell and spigot pipe, Class B and heavier, f.o.b., on regular lots of pipe:

	4-In.	6-In. and Over
Birmingham mill	$40.00@$41.00	$37.00@$38.00
Burlington (N. J.) mill	40.00	37.00
Chicago	48.20@ 49.20	45.20@ 46.20
New York	42.90	39.90
Pittsburgh	48.80@ 49.80	45.80@ 46.80
St. Louis	47.00@ 48.00	44.00@ 45.00
San Francisco	50.00@ 51.00	47.00@ 48.00

Gas pipe and Class A, $3.00 per ton extra.

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.16	$0.26	$0.45	.....	.....	.....	.....
Baltimore	.10	.30	.58	.....	$1.93	.....	$6.50
Birmingham	.25	.40	.65	$1.50	2.75	$3.90	5.83
Boston	.185	.30	.555	1.35	2.25	3.70	6.50
Chicago	.15@.18	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.135	.21	.405	1.05	1.89	3.456	5.4325
Cleveland	.189	.294	.567	1.35	2.43	4.824	7.38
Dallas	.25	.375	.68	1.60	2.85	.....	.....
Denver	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	5.12	7.91
Kansas City	.21	.29	.52	.....	1.90	3.80	.....
Los Angeles	.21	.2825	.51	1.186	2.03	3.39	5.09
Minneapolis	.16	.25	.50	1.15	1.85	3.49	4.97
Montreal	.36	.53	.78	1.48	2.75	4.20	.....
New Orleans	.195	3.25	.585	1.10	2.11	.....	.....
New York	.185	.29	.56	1.35	2.45	4.60	7.07
Philadelphia	.117	.182	.351	1.05	1.89	3.60	5.6375
Pittsburgh	.0945	.147	.2835	.85	1.53	3.024	4.8175
St. Louis	.1645	.26	.468	1.092	1.872	3.65	4.80
San Francisco	.1925	.275	.495	1.155	1.98	3.30	4.95
Seattle	.22	.30	.54	1.26	2.16	3.50	.....

CLAY DRAIN TILE—Prices delivered by dealers, per 1,000 lin.ft.:

Size, In.	New York	Birm'ham	St. Louis	Dallas	San Fran.	Seattle
4	$55.00	$56.00	$50.00	$63.00	$67.50	$60.00
6	112.00	112.00	85.00	100.00	112.50	112.00

Miscellaneous

LINSEED OIL—Raw oil, f.o.b., in 1- to 4-bbl. lots, per lb.:
New York.... $0.15 Chicago.... $0.154 Minneapolis.. $0.159

WHITE AND RED LEAD—Base price per 100-lb. keg, f.o.b., New York: White, dry, $13.75; White, in oil, $14.25; Red, dry, $13.75; Red, in oil, $15.25.

CHEMICALS—Water, sewage treatment, road work, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb	$1.90@$2.00
Sulphate of copper, in bbl., per 100 lb	5.50@ 6.00
Soda ash, 58%, in bags, per 100 lb	1.32@ 1.35
Chlorine, cylinders, per lb	.04½@ .06
Bleaching powder, in drums, f.o.b. works, per 100 lb	2.00@ 2.10
Calcium chloride, flaked, in drums, f.o.b. works, per ton	22.75

MANILA ROPE—The number of feet per pound for the various sizes is as follows: 5-in., 7-ft., 6-in.; ¾-in., 6-ft., 1-in.; ⅞-in., 4-ft., 5-in.; 1-in., 3-ft., 8-in.; 1¼-in., 2-ft., 5-in.; 1½-in., 1-ft., 8-in. Following prices are quoted by dealers per pound for ¾-in. and larger†

Atlanta	$0.25	Kansas City	$0.25
Baltimore	.225	Los Angeles	.25
Birmingham	.26	Minneapolis	.23
Boston	.215	Montreal	.[illegible]
Chicago	.20	New Orleans	.25
Cincinnati	.21	New York	.21
Cleveland	.21	Philadelphia	.23
Dallas	.26	San Francisco	.205
Denver	.24	Seattle	.215
Detroit	.23	St. Louis	.225

BUILDING PAPER—Black, in carloads, per roll of 500 sq.ft., f.o.b., producing point $2.00

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.77

ROOFING MATERIALS—Price f.o.b., New York, delivered by dealers to contractors in carloads:

Asphalt felt, per 100 lb	$2.60
Tar felt, per 100 lb	2.60
Asphalt coating, per gal	.34½
Tar pitch, in 350 lb. barrels, per ton	28.00

PREPARED ROOFINGS—Prices delivered by dealers to contractors, in each load, f.o.b. New York, per square:

Single shingles, slate finish, sufficient to cover 100 sq.ft.	$6.12
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	5.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs.	2.50

WINDOW GLASS—United inches 25, bracket size 6:8 to 10x15, single or double thickness, discount from jobbers' list (Sept. 15, 1928), at New York warehouses:
AA..... 83% A..... 86% B..... 88%

EXPLOSIVES—Manufacturers' quotations per pound for dynamite delivered in small lots, under 200 lb.:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.2225	.2450
Birmingham	.22	.245	Montreal	.20	.24
Boston	.22	.25	New Orleans	.195	.22
Chicago	.195*	.22*	New York	.255‡	.2775‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.185	.2465	St. Louis	.215	.235
Denver, f.o.b.	.19	.2125	San Francisco	.155	.18
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

New York—Timbers, No. 1 Common, rough, delivered to contractor at site of job, in 20 ft. lengths and under, per M. ft., b.m.:

	Long-leaf Yellow Pine	Douglas Fir
3x4 to 8x8	$54.00	$39.00
3x10 to 10x10	64.00	40.00
3x12 to 12x12	74.00	42.00
3x14 to 14x14	86.50	50.00

Chicago—Prices, f.o.b., in carloads, No. 1 Common, rough per M. ft. b.m. For delivery to job from stock, in truckloads, add $10 per M. ft., b.m.:

	20 Ft. and Under Long-Leaf Yellow Pine	Up to 32 Ft. Douglas Fir
3x4 to 8x8	$43.00	$41.00
3x10 to 10x10	50.50	41.00
3x12 to 12x12	62.50	41.00
3x14 to 14x14	74.50	42.00

San Francisco—Douglas fir, No. 1 common, rough, at yards. For delivery to contractor at site of job, add $1.50 to $5 per M. ft., b.m.:

	10-16-18 and 20 Ft.	22 and 24 Ft.
3x3 and 4	$33.00	$36.00
3x6 and 8	33.00	36.00
3x10 and 12	33.00	36.00
3x14	37.00	39.00

Other Cities—Delivered by dealers, No. 1 Common, rough, per M. ft., b.m.:

	8x8-In. x 20 Ft. and Under				3x12 to 12x12-In. 20 Ft. and Under	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	$55.00	.....	.....	.....	$65.00	.....
Baltimore	36.00	$50.00	$53.50	$61.00	75.00	$50.25
Birmingham	53.00	.....	.....	.....	80.00	.....
Boston	52.50	45.00	47.00	48.00	60.00	40.00
Cincinnati	47.50	58.50	.....	.....	65.00	52.50
Cleveland	63.00	63.00	.....	.....	63.00	63.00
Dallas	55.00	55.00	55.00	55.00	55.00	55.00
Denver	.....	47.50	47.50	47.50	.....	46.00
Detroit	55.00	53.00	.....	.....	68.50	53.00
Kansas City, Mo.	47.50	57.50	.....	.....	52.50	55.00
Los Angeles	.....	42.50	.....	.....	.....	44.50
Minneapolis	58.00	52.25	38.25‡	.....	58@60	52.25
Montreal	50.00	48.00	.....	.....	56.00	48.00
New Orleans	52.00	48.00	.....	44.00	67.00	65.00
Philadelphia	50.00	43.00	42.00	48.00	60.00	43.00
Pittsburgh	65.00	70.00	75.00	65.00	65.00	65@72
St. Louis	48.00	43.00	42.00	.....	60.00	44.00
Seattle	.....	21.00	.....	.....	.....	21@22

	1x10 In. x 16 Ft. and Under			2x10 In. x 16 Ft. T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	$42.50	.....
Baltimore	56.00	$45.00	$44.00	.....	.....
Birmingham	36.00	.....	.....	45.00	.....
Boston	46.00	40.00	42.00	48.50	$45.00
Cincinnati	61.00	52.50	.....	38.00	50.00
Cleveland	60.00	55.00	.....	65.00	58.00
Dallas	60.00	.....	.....	55.00	.....
Denver	.....	38.00	38.50	.....	44.00
Detroit	47.50	45.00	.....	48.50	47.00
Kansas City, Mo.	57.50	57.50	57.50	57.00	48.00
Los Angeles	.....	41.50	.....	.....	55.00
Minneapolis	53.00	46.00	39.75‡	51.00	45.00
Montreal	56.00	.....	.....	.....	.....
New Orleans	49.00	49.00	.....	59.00	55.00
Philadelphia	52.00	43.00	41.00	55.00	44.00
Pittsburgh	50.00	60.00	59.00	42.00	.....
St. Louis	43.00	42.00	41.00	45.00	42.00
Seattle	.....	21.00	.....	.....	20.00

*Long-leaf yellow pine. †Douglas fir. ‡F.o.b.

PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per lineal foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Barge	Rai
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.2[illegible]
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.36
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.31
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.33	.41
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.38	.45

Unit Prices From Current Construction Bids

Bids Received for Engineering Service for Lima (Ohio) Sewage and River Projects

SEALED proposals were received by the city manager of Lima, Ohio, March 22, 1930, for engineering service in connection with the design, construction and operation of a sewage-disposal plant and for the design and supervision of Ottawa River improvement. Bids, asked on the basis stated below, were received from seventeen engineering firms:

Sewage Disposal Plant—(1) Design. (2) Supervision of construction. (3) Supervision of operation for (1) twelve months, (2) for eighteen months. (4) Total engineering.

River Work—(1) Design. (2) Supervision of construction.

Proposals were asked in terms of both percentage and lump sum for each of the above elements. Type of plant tentatively approved is activated sludge. The river improvement consists of deepening and widening the channel and providing a series of movable shallow dams. Estimated costs are $770,000 for the plant and $200,000 for the river work.

The tabulation and following notes are from the official listing of bids. For the design and supervision of construction of the sewage-disposal plant all bids were based on construction cost except: (4) Diehl estimated cost of $970,000 instead of engineer's estimate of $770,000; (6) Jones graduated his bids according to cost from 1.75 per cent for design and 2.75 per cent for supervision if cost is $600,000-$770,000, to 3 per cent for design and 5 per cent for supervision if cost is "less than $475,000," with a total fee not to exceed $39,300, or, if city engineer does part of work, $29,800, these fees "based on construction cost of $525,000." Jones also offers to deduct $500 from design fee if a specified site is slected for the disposal plant. Where there are two bids in the last column, these cover respectively twelve and eighteen months' supervision of operation of the plant except in the cases of Jones and of Alvord, Burdick & Howson, as noted below. I. C. Brown is city manager; LeRoy E. Miller, city engineer.

1. *George A. Reese* submitted two proposals, the second ($6,000 less) on the basis of the city's furnishing assistant engineers and inspectors on the construction of the plant and G. A. Reese furnishing resident engineer; $1,000 deduction is allowed for data already secured on local conditions.

2. *Sterling Engineering Co.* bids 5 per cent of contract price if river work is included.

3. *George B. Gascoigne*—Supervision of construction of plant includes resident engineer, but not assistant engineer and inspectors. These are to be furnished by city and if not selected by Gascoigne his bid is increased from 2.5 per cent to 3 per cent. Supervision of river work includes only resident engineer. From total bid deduct $2,500 "as per proposal dated Feb. 13, 1929."

5. *Charles DeLeuw*—For design of both plant and river work, bid is $22,000, or 2.5 per cent of construction cost. For supervision of both projects, bid is $19,000, or 2 per cent. For all work, including river, the bids are $46,000, or 4.75 per cent, for twelve months and $48,500, or 5 per cent, for eighteen months.

6. *H. P. Jones*—Bid on supervision of construction is $11,000, or 1.7 per cent, if city engineering department assists. For design of river improvement, no charge if city does surveying and drafting, 1.25 per cent otherwise; for supervision, increase bid of 2 per cent to 4 per cent if city engineering department does not assist. Total fee not to exceed $39,300, including eighteen months' supervision; lower bid covers service if city engineering department assists.

7. *John M. Rice*—For supervision of construction, city furnishes assistant engineers and inspectors. Bids for river improvement included in total.

8. *Hoad, Decker, Shoecraft & Drury*—Advise that plant can be built for $700,000, excluding land and engineering.

10. *Pate, Bacon & Hamann*—Total bid, including river work, is $35,900, or 4.5 per cent, and $37,400, or 5.16 per cent, for twelve and eighteen months' operation respectively.

11. *J. N. Chester*—Total bid, including river work, is $39,500 (twelve months) and $40,000 (eighteen months).

13. *The A. H. Smith & Niles Co.*—For each $40,000 saved city, 0.5 per cent added to fee, and for each $40,000 over $970,000, deduct 0.5 per cent.

14. *Alvord, Burdick & Howson*—First total of 5.5 per cent covers design and supervision of construction; second includes also supervision of operation for eighteen months.

16. *George Champe*—Bid for supervision of operation (eighteen months) is included in design and construction bid.

17. *Hubbell, Hartgering & Roth*, Detroit, state that they do not make practice of entering into competitive bidding and give their customary fee as 6 to 8 per cent.

	Sewage-Disposal Plant					River Improvement	
			Supervision of Operation				Supervision of
	Design	Supervision of Construction	12 mo.	18 mo.	Total for Disposal Plant	Design	Construction
1. Geo. A. Reese, Canton	$15,600 (2.6%)	$18,000 (3%)	$2,400 (0.4%)	$3,600 (0.6%)	$36,000 (6%) 37,200 (6.2%)	$4,000 (3%)	$4,000 (3%)
2. Sterling Engineering Co., Cleveland	25,000 (3%)	21,000 (2.5%)	3,500 (5%)	5,250 (0.75%)	50,000 (6%)	(2.5%)	(2.5%)
3. George B. Gascoigne, Cleveland	(3%)	(2.5%)	(0.5%)	(0.5%)	6 to 6.5%	(3%)	(2.5%)
4. George C. Diehl, Inc., Buffalo	18,340 (1.9%)	16,490 (1.7%)	4,620 (0.6%)	6,160 (0.8%)	39,540 (4.2%) 41,080 (4.4%)	(1.9%)	(1.7%)
5. Charles DeLeuw & Co., Chicago	19,000 (2.5%)	17,500 (2.25%)	5,000	7,500	41,500 (5.25%) 44,000 (5.5%)	5,000 (2.5%)	4,000 (2%)
6. H. P. Jones Toledo	11,000 (1.75%)	18,000 (2.75%)	1,200	1,800	39,300 29,800	....	4,000 (2%)
7. John M. Rice, Pittsburgh	35,000 (4%)	10,000 (1%)	5,000 (0.75%)	7,500 (1%)	50,000 (5%) 52,500	Included in total bid	
8. Hoad, Decker, Shoecraft & Drury, Ann Arbor	16,800 (2.4%)	11,200 (1.6%)	1,200 (0.17%)	1,600 (0.23%)	29,200 (4.17%) 29,600 (4.23%)	No separate bid	
9. Barstow & McCurdy, Akron	22,000 (2.5%)	26,000 (3.25%)	2,400	3,300	47,000	Included in total bid	
10. Pate, Bacon & Hamann, Detroit	14,800 (2.5%)	10,000 (1.5%)	4,800 (0.7%)	6,300 (1.05%)	29,600 (4.5%) 31,100 (5.16)%	3,800 (2.5%)	2,500 (1.5%)
11. J. N. Chester, Pittsburgh	15,000 (2.5%)	15,000 (2.5%)	1,500 (0.25%)	2,000 (0.35%)	31,500 (5.25%) 32,000 (5.35%)	4,000 (2.5%)	4,000 (2.5%)
12. Pearse, Greeley & Hansen, Chicago	24,000 (2.75%)	24,000 (2.75%)	Included in total bid		50,000 (5.5%)	Included in total bid	
13. A. H. Smith & Niles Co., Toledo	(3.25%)	(2.75%)	(0.5%)	(0.75%)	(6.75%)	(6%)	.....
14. Alvord, Burdick & Howson, Chicago	..... (3%)	..... (2.5%)	5,000	6,500	(5.5%) 58,000 (6%)	....	....
15. Black & Veatch, Kansas City	28,100 (3%)	24,250 (2.5%)	3,600 (0.5%)	5,400 (0.75%)	56,200 (5.7%) 58,000 (5.9%)	(2.5%)	.....
16. Geo. Champe, Toledo	..... (2.5%)	..... (3.5%)	Included in design and construction bid		..... (6%)	..... (2.5%)	..... (3.5%)

Unit Prices From Current Construction Bids

Boiler Equipment for Municipal Plant, Fremont, Neb.

FREMONT, Neb., through Burns & McDonnell Engineering Co., Kansas City, Mo., opened bids Dec. 18, 1929, on a new boiler, stoker, air preheater and economizer for its municipal power plant. Item specifications and prices follow:

Boiler

Type	A* Long drum	B Cross drum	C Long drum
Heating surface, sq.ft.	6,080	6,050	6,044
Working pressure, lb. gage	300	300	325
Superheat at 250% rating, deg. F.	170	....	172
Pressure drop at 250% rating, lb.	7	....	10
Draft loss through boiler-250% rating, in.	0.85	0.65	....
Exact gas temperature, 250% rating, deg. F.	600		
Cost boiler, superheater and soot blowers	$18,032	$17,685	$20,980

Bidders were (A) Murray Iron Works (awarded contract), (B) Combustion Engineering Co., (C) Babcock & Wilcox.

*Duplicate of existing unit and included number of soot blower elements as specified.

Air Preheater

Type	A Plate elements	B 2-pass plate	C Plate	D* Plate
Heating surface, sq.ft.	3,040	3,040	2,478	2,484
Draft loss, 250% rating, in.	0.78	0.55	0.41	1.40
Cost with induced draft fan	$3,390 (no fan)	$3,495 (no fan)	$3,982	$4,435

Bidders were: (A) Combustion Engineering Co., (B) Babcock & Wilcox; (C) B. F. Sturtevant Co.; (D) Foster Wheeler Corp. (awarded contract).

*Duplicate of existing units.

Stoker

Type	A Underfeed	B Underfeed	C Chain	D* Underfeed
Number of retorts	7	6	....	6
Number of tuyeres	34	25	....	25
Coal, lb. per sq.ft. at 250% rating	47.1	55.4	50	47.5
Furnace efficiency at 250%	80	77.5	77	74
Cost stoker and forced draft fan	$8,628	$8,907	$9,060	$9,400

Bidders were: (A) Riley Stoker Corp.; (B) Combustion Engineering Co.; (C) Johnson & Jennings Co.; (D) American Engineering Corp. (awarded contract).

*Duplicate of existing unit and cost por square foot grate area lowest.

Economizer

	A*	B
Heating surface, sq.ft.	864	791
Draft loss at 250% rating, in.	1.25	0.4
Cost without induced draft fan	$4,500	$5,250

Bidders were: (A) Foster Wheeler Corporation, (awarded contract); (B) Babcock & Wilcox.

*Lowest price and duplicate of existing unit.

Data for Curtiss Depot Hangar, Louisville

THE Curtiss-Wright Flying Service builds two types of hangar: (1) a depot hangar which provides for a general staff, including manager, operation manager, office force, accessory and airplane sales forces, school, shop, parts department, and airplane storage; (2) a service hangar. Description and contract prices of a depot hangar constructed at Louisville, Ky., in 1929, of steel, tile, brick, cement and plaster are presented below by Charles S. Russell, engineer, of the Service.

Dimensions—The hangar proper is 100x120x20 ft. (240,000 cu.ft.), with straight sliding doors 20 ft. high on the 100-ft. side. Total ceiling area is plastered. As the illustration shows, there is a lean-to the full length. This is 20x120x29 ft., with an outset 10x42x14 ft., or 75,480 cu.ft. The floors of both hangar and lean-to are concrete. Lean-to space is divided as follows:

	Sq.Ft.		Sq.Ft.
Foyer	320	School room	800
Waiting room	800	General office	460
Accessory sales and stock room	288	Manager's office	120
Shop	1,100	Boiler room	500
Showers and toilets	323	Dark room	84
Locker room	143	Observation porch	320
		Halls, stairways	500
		Total lean-to	5,758

Contract Prices—The prices of the sixteen items of work are given below, with the percentage that each is to total cost:

		Per Cent of Total
Foundation, reinforced (includes excavation, grading)	$5,500	7
Steel and erection	10,000	13
Tile, common and face brick	12,400	16
Roof	3,500	5
Lath and plaster	5,500	7
Floors, reinforced concrete	3,800	4
Aprons	2,600	3
Stone work	700	1
Painting and glazing	2,700	4
Carpentry	11,000	14
Doors erected	4,500	6
Steel sash	1,000	1
Heating	5,500	7
Plumbing	3,500	5
Electrical (including fixtures)	3,000	4
Extras: screens, landscape, walks, drives	2,000	3
Total cost	$77,200	100

Total volume of hangar and lean-to, 315,480 cu.ft.
Total cost per cu.ft., $0.41.

Bridge Approaches in Florida

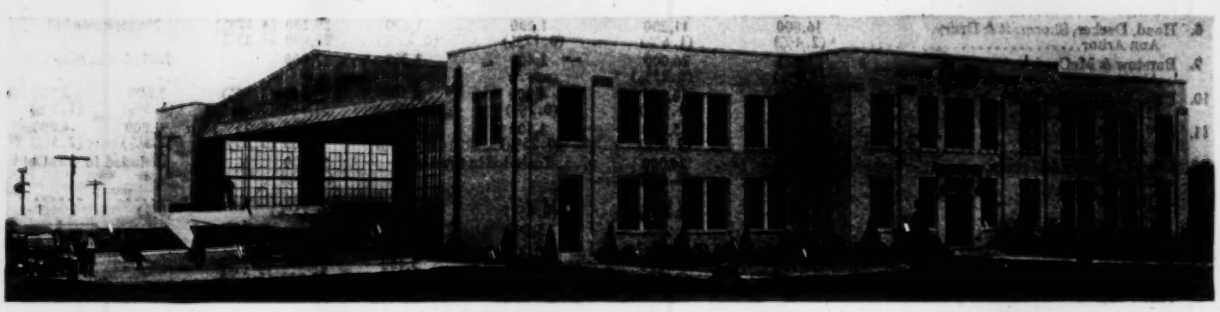
FLORIDA State Highway Department opened bids March 5, 1930, for approaches to Alifia bridge, in Hillsboro County. Five bids were submitted, the difference between the lowest and the average being 11 per cent. The accompanying tabulation lists the prices of the lowest three bidders: (A) C. C. Moore Construction Co., DeFuniak Springs, $21,619; (B) J. Johnson, Lakeland: $24,029; (C) F. B. Beasley, Inc., Tampa, $24,773.

	A	B	C
18,638 cu.yd. excav.	$0.80	$0.925	$0.95
3,690 sq.yd. broken stone base	1.20	1.30	1.35
3,690 sq.yd. single bituminous treat	0.30	0.28	0.30
1,956 lin.ft. woven wire guard rail	0.60	0.49	0.50
1,956 lin.ft. resilient plate guard rail	0.70	0.60	0.58

Average Dredging Costs in Canada

(Department of Public Works)

	Cost Per Cu.Yd. Sand	Rock-Sand, Gravel-Mud	Mud-Sand	Clay-Rock, Gravel	Small Boulders
Nova Scotia	$0.6737	$0.7025	$0.6450	$1.9216	$0.2546
Prince Edward Island	.....	0.3536	0.3542	0.7939	.....
Quebec	0.4164	0.9454	0.6978	0.7437	1.8506
Ontario	0.4295	.....	.....	.....	.....
Manitoba	.....	.....	0.1319	0.8401	1.5430
British Columbia	0.1403	.....	0.0850	.....	0.2164



CURTISS FLYING SERVICE HANGAR, LOUISVILLE, KY.